Trends in pursuing LEED certification credit points

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Conservation of energy and protecting the environment has becoming a rapidly increasing global concern. To address these concerns, initiatives are being taken worldwide and specifically by the construction industry. One such initiative in the construction industry is Leadership in Energy and Environmental Design (LEED). It is a building rating system developed by the United States Green Building Council (USGBC) that sets benchmarks to make building design and construction green and sustainable and then assess the building performance. USGBC has developed a suite of rating systems based on the different types of buildings including LEED NC for New Construction, LEED CI for Commercial Interiors and many more. LEED NC has total of 69 possible points that can be earned, where a building is rated as Certified, Silver, Gold or Platinum based on the number of points achieved by the design and construction. In a preliminary analysis of these points pursued by LEED 2.0, 2.1 and 2.2 versions, it is apparent that there are a number of points that are used infrequently.

The reasons why these points are seldom used has not been studied. This research aims to identify LEED certification points that are not pursued in most construction projects. The findings from this research will help in identifying the under-utilized points in the current rating system. Furthermore, the outcomes of this study can be used to assist USGBC to improve the rating system, by focusing on the possible motivation for LEED Accredited Professional (AP) to go for these points.

Keywords: Energy Efficiency, Green Buildings, Green Construction, LEED, LEED NC, Sustainability, USGBC

Introduction

Since the industrial revolution, humans have consumed natural resources in ever increasing quantities. The 1970's oil crises shook the industrial world by highlighting how dependent we have become on resources that are finite and should be consumed wisely. As a result, energy conservation and a search for alternative energies that can be scaled in consumption and have a long term horizon has become a major subject of concern for businesses and humanity (Fernández-Solis, 2007a). Research indicates that, approximately 30% to 40% of the natural resources are being consumed in developing countries by the building industry (Pulselli, Simoncini, Pulselli, Bastianoni, 2007). Since buildings consume a significant portion of energy that is mostly dependent on non-renewable resources, reduction in energy consumption along with the quest for new sources of clean renewable energy have become the focus of a movement that aims to secure our future and also improve our natural environment.

The scope of making the world green by concentrating just at the building sector can be understood by looking at the current figures associated to buildings, their resource consumption and their contribution towards the carbon emission. Figures 1, 2 & 3 (Green Building Research, USGBC website) show that in the United States alone, buildings account for 70% of electricity consumption, 36% of the total energy use, and 39% of greenhouse gas emissions. The US is also responsible for 40% of raw materials use, 30% of waste output (136 million tons annually), and 14% of potable water consumption. A number of cases following green and sustainable construction practices at their best, show that there is a scope of saving up to 80% energy at little or no extra cost (Harvey, 2006; O¨hlinger, 2006). Greenhouse gasses are also a matter of concern as extensive research is being done in this field. It has been estimated that by following green building practices in developed countries, 29% of the carbon dioxide emission can be reduced cost

effectively whereas in developing countries, carbon dioxide emission can be reduced up to 52% at negligible extra cost (Vostatz, and Novikova, 2007).

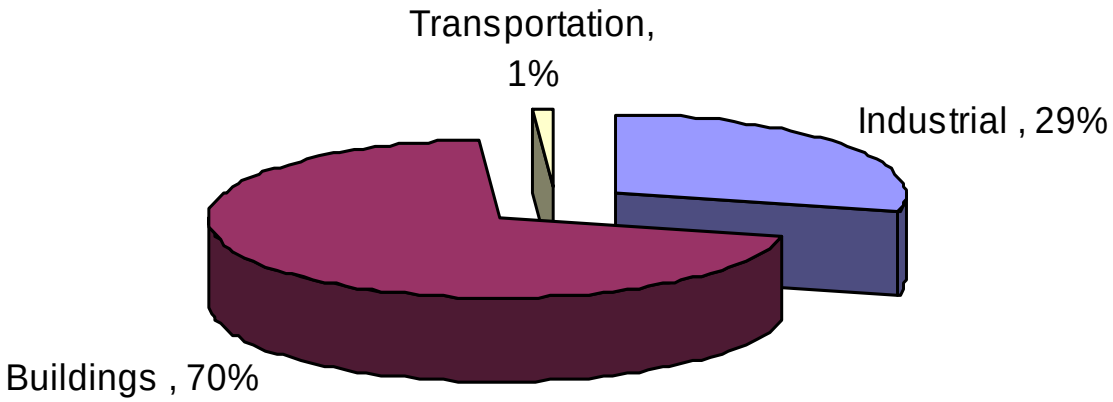

Figure1: Electricity Consumption data by industrial sector (Green Building Research, n. d.)

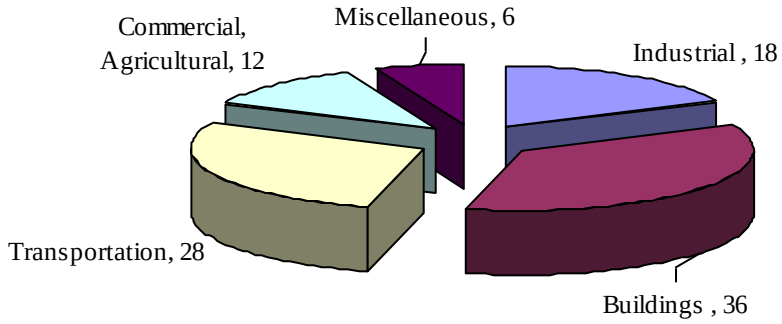

Figure 2: Energy Consumption data by industrial sector (Green Building Research, n. d.)

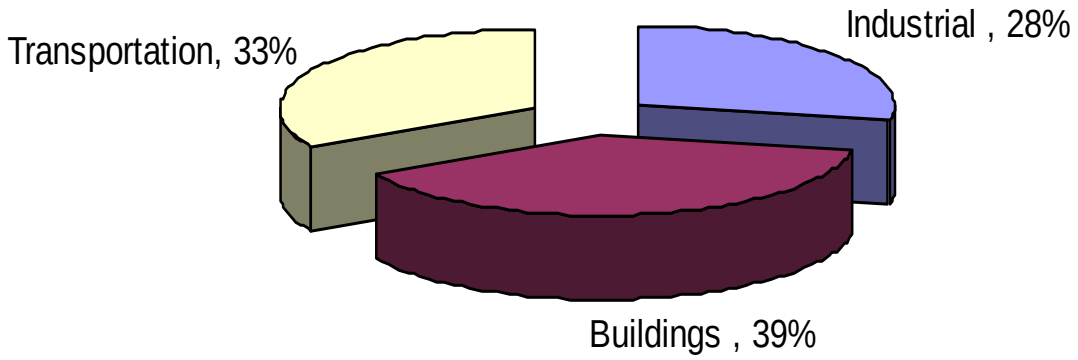

Figure 3: Green House Gas Emission data by industrial sector (Green Building Research, n. d.)

Global initiatives primarily towards the goal of energy conservation and reduction of carbon emission in the building sector are: LEED®, a building sustainability rating system developed by the United States Green Building Council (USGBC) (Watson 2001), Building Research Establishment Environmental Assessment Method (BREEAM™) is a similar rating system and is considered one of the most successfully executed program for promoting sustainability in buildings worldwide (Misrty, 2007). GBTool™ is another system which approaches sustainability in a very comprehensive way and is being used in over 21 countries for last 6 years (Cole 2002; Cole and Larsson 2002; Epsten and Larson 2002). Some other popular systems used for similar purpose are BEPAC – Building Environmental Performance Assessment Criteria, being used in the UK and Canada; ABGR – Australian Building Greenhouse Rating, developed in 2005 by Australia Department of Commerce; BASIX – Building & Sustainability Index, developed in 2004; CASBEE – Comprehensive Assessment System for Building Environmental Efficiency, developed in 2004 by the Japanese government and construction industry (Cole 2005); and the Green Globes, developed in 2000 in Canada and USA. These are models created to implement the principles of energy conservation in building design and construction. Indirectly, they provide opportunities for cost-effective reduction of pollution and greenhouse gases and improvement in energy security (Rajgor and Gail, 2005). These organizations and rating systems establish benchmarks for the design, construction and operation of what some call 'high performance green buildings'.

Increased energy efficiency and new resources of energy address the escalating amount of greenhouse gases (GhG) (Fernández-Solis, 2007d) and it is estimated that the building sector contributes to nearly one half of the total carbon emission. LEED is a building rating system developed by the USGBC (USGBC, 2003) that aims at setting benchmarks in the field of green and sustainable design and construction and assesses the building performance. LEED approaches sustainability through energy conservation, better use of products, minimum waste and indirectly, the reduction of greenhouse gases. Based on the building and construction type, LEED has developed a suite of building rating systems using LEED for New Construction as a template such as: Existing Buildings, Commercial Interiors, Core & Shell, Schools, Healthcare, Homes & Neighborhoods. The distribution of building types rated under LEED NC in 2006 is shown in figure 4.

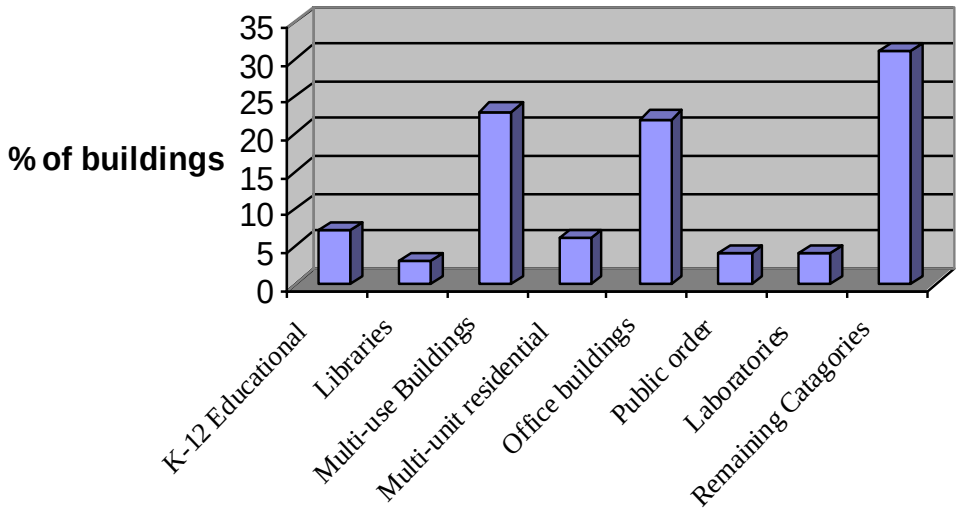

Figure 4: Building Type Distribution for buildings using LEED NC in 2006 (USGBC, 2008a, 2008b)

On the bases of its rating system and the number of points a building gets in the LEED point checklist, a LEED Accredited Professionals provides the information that ultimately may result in rating the building as Certified, Silver, Gold or Platinum (LEED Rating System, n. d.). While contributing towards the goal of energy conservation, these buildings usually achieve higher real estate value (especially in an environment where energy prices keep rising), which acts as an added motivation for the developers and builders to go green. Figures show that this rating system is gaining recognition rapidly and already has approximately 49,500 LEED Accredited Professionals, more than $12 billion in construction of green buildings in 2008, and everyday more that $460 million worth of construction registers with LEED (Green Building by numbers, 2008). LEED professionals and other experts suggest that the energy efficiency and sustainability of a building should be achieved by an absolute and intense design and construction process considering all the energy efficiency factors as well as the type of construction and building materials that can be used. The discipline of energy efficient construction offers a significant scope for research and innovation (Chwieduk and Dorota, 2003).

A study of a number of LEED rated buildings done at the Anderson School of Management, University of California, Los Angeles, shows that there is a degree of preference associated with each LEED rating point, i.e., there are LEED rating points that are preferred over other. In other words, there are some points that can be called the “low hanging fruits” (Cryer, Felder, Matthews, Okrent, Pettigrew, 2006). The reason of such practice might be related of factors such as cost, feasibility or applicability of the rating point. Further research may be required to make the LEED rating systems more comprehensive and user friendly. The information about the LEED certified buildings has been made accessible on the USGBC web site in the form of case studies (USGBC, 2008). The data about the buildings is an up-to-date list of all the buildings rated under the various LEED rating systems in versions 1.0, 2.0, 2.1 and 2.2. With this resource, studies can be done and the LEED rating system can be fine-tuned.

Problem Statement

The purpose of this study is to identify and analyze the trends in pursuing LEED certification points in projects.

Research Objectives

1. Identify and study the frequency of LEED categories and points used in various projects.

2. Find out the credit points that have not been pursued in most projects.
3. Identify and analyze the pattern of point, if any, that have not been used in most projects.

Assumptions

1. The data related to LEED building certification was collected from reliable USGBC public source in the form of case studies, and is, therefore, considered valid.
2. The USGBC case studies provide all the required and pertinent information.
3. There is no appreciation or significant difference between projects done under LEED NC version 2.0, 2.1 and 2.2 for the purpose and intent of this work.

Delimitations

1. The study is limited to the buildings rated under LEED NC in the USA.
2. The buildings rated under LEED NC versions 2.0, 2.1 and 2.2 on or before August 1st, 2008) are considered for the study.
3. The number of buildings to be studied will be limited to a set composed of all the projects available on the case study database of the USGBC website.

Literature Review

The built environment has most evident and long lasting effect on the environment. A building becomes a capital asset for the general economy into the near future, its typical life cycle of 50 years. This capital asset generates capital, consumes resources and directly or indirectly produces Green House Gasses emissions through its use of fossil fuels (Fernandez-Solis, 2007d).

In the United States of America, the building industry accounts for 8 percent of the gross domestic product (GDP) and consumed 40 percent of raw materials (Kibert, 2007). Since it is such a big entity, the possible contribution to wards the goal or reducing adverse environmental effects can be great. The first effort in this direction was made in 1970 when the first Earth Day was celebrated with the formation of U.S. Environmental Protection Agency which is still very active and on the fore front. With several other initiatives came the USGBC in 1993.

After the establishment of USGBC in 1993, it took four years to develop their first green building rating system and was launched in 1998 as LEED 1.0 beta version (Kibert, 2007). With constant improve and modifications, USGBC came out with more versions named LEED 2.0, LEED 2.1 and LEED 2.2. All these rating systems were quite similar to each other and were based on similar energy and environmental principles. LEED is a suit of building rating systems which includes LEED-EB (Existing Buildings), LEED-CI (Commercial Interiors), LEED-SC (Core and Shell Projects), LEED-H (Homes), and LEED-ND (Neighborhood Development). LEED-NC is the most widely used rating system and was primarily designed to be used for office buildings but is being used for other buildings also.

LEED building rating system has been developed after extensive research in the field of sustainable and green construction. LEED presents itself as a product and a "flexible yet consistent rating system" (USGBC, 2003). The LEED NC system is based on 69 points and a building can be certified as LEED Certified with 26 to32 pints, LEED Silver with 33 to 38 points, LEED Gold with 39 to 51 points and LEED Platinum with 52 to 69 Points, see graphic depiction in Figure 5.

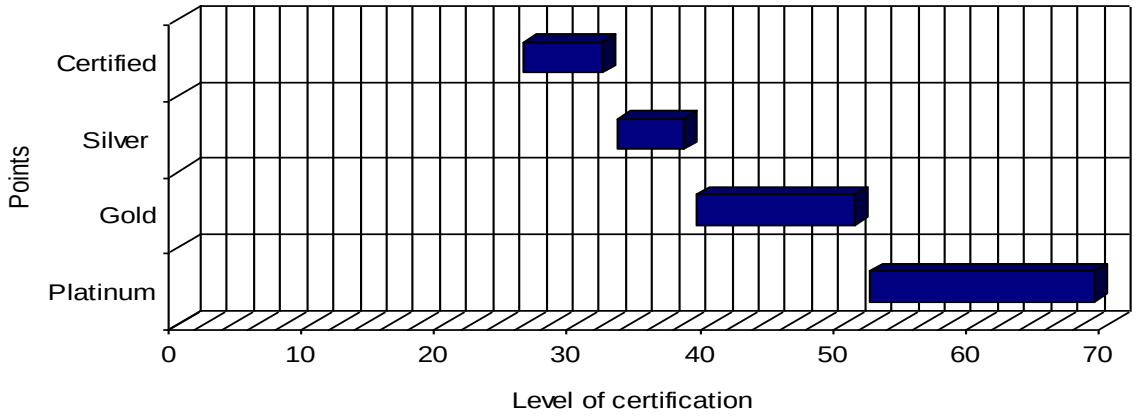

Figure 5: Points required for different levels of ratings in LEED NC 2.2 (USGBC, 2008)

It has been seen in most cases that as the level of LEED certification increases, the effort also increases where as the percentage increase in cost vary from project to project. Research shows that the additional cost of getting a building LEED certified is less than 1%, LEED Silver is 2.1%, LEED Gold is 1.8%, and LEED Platinum is 6.5% (Kats, Alevantis, Berman, Mills & Perlman, 2003).

A report prepared by USGBC called The Energy Performance of LEED NC Buildings shows that the LEED rated buildings show an average of 25% -30% better performance than the national average of building performance. Also, the higher level of rating i.e. LEED Gold and Platinum deliver up to 45% better performance than non-LEED buildings. By going green with an extra upfront cost of 2%, one can save up to 10 times of that extra upfront cost in a life-cycle (Kats, Alevantis, Berman, Mills & Perlman, 2003). Green buildings tend to achieve significant added exchange value (Kibert, 2007).

Criterion underlying certification points

The criterions to achieve points are divided in LEED NC-2.2 into six basic categories termed as Sustainable Sites, Water Efficiency, Energy & Atmosphere, Materials & Resources, Indoor Environmental Quality, and Innovation & Design Process. Figure 6 shows the number of points in each category and percentage contribution of each category to the total number of points in LEED NC (Category; Number of points; Percentage of points).

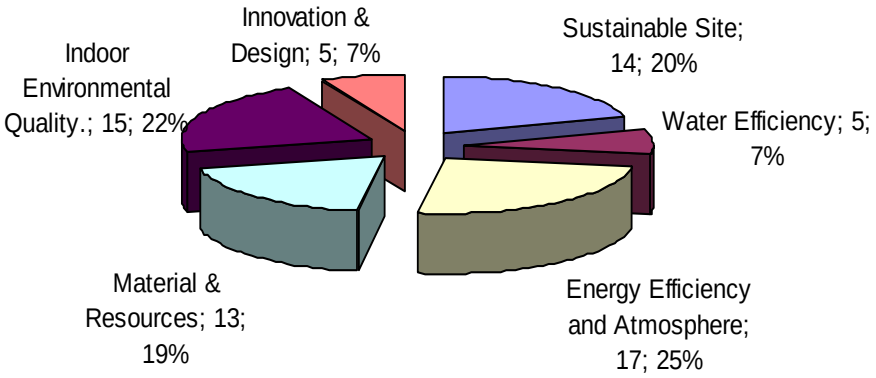

Figure 6: Certification Point distribution in LEED NC 2.2 (USGBC, 2008)

Sustainable site

Intent of implementation of practices to achieve points in this category is to come up with solutions and techniques to make the construction site sustainable and affect the surroundings as minimum as possible. The sustainable sites category includes activities that conserve and restore the site ecosystem. This category also encourages the use of alternative and green transportation, maximizing open space, preventing water pollution, storm water management etc. (Cryer, Felder, Matthews, Okrent, Pettigrew, 2006).

Sustainable site section of the project checklist consists of one perquisite point for Soil Erosion and Sedimentation Control along with 14 other achievable points. In this category, points can be achieved for Site Selection, Urban Redevelopment, Brownfield Redevelopment, Alternative Transportation (Public Transportation Access, Bicycle Storage & Changing Rooms), Alternative Fuel Refueling Stations, Parking Capacity, Reduced Site Disturbance-Protect or Restore Open Space, Reduced Site Disturbance-Development Footprint, Storm-water Management-Rate or Quantity, Storm-water Management-Treatment, Landscape & Exterior Design to Reduce Heat Island –Non Roof, Landscape & Exterior Design to Reduce Heat Islands- Roof, and Light Pollution Reduction.

Water Efficiency

The purpose of implementation of practices and achieve points in this category is to conserve water and increase efficiency of buildings in terms of water use. This results in savings in terms of reduced water cost. This section provides the opportunity to reduce water consumption significantly with considerably less effort (Cryer, Felder, Matthews, Okrent, Pettigrew, 2006).

This section gives the opportunity to achieve five points including Water Efficient Landscaping-Reduce by 50%, Water Efficient Landscaping-No Potable Use or No Irrigation, Innovative Wastewater Technologies, Water Use Reduction- 20% Reduction, and Water Use Reduction-30% Reduction.

Energy & Atmosphere

This section of LEED credits concentrates on conservation on energy and greening the atmosphere by focusing on practices like use of energy from renewable sources. It also focuses on reducing the use of energy in buildings by optimizing the lighting and ventilation requirements buy use of technology to control these factors. This in turn benefits by reducing the energy cost and the impact on the environment.

This section has three prerequisite points including Fundamental Building Systems Commissioning, Minimum Energy Performance, and CFC Reduction in HVAC&R Equipment. Apart from the perquisite points, it includes 17 points which can be achieved for Optimize Energy Performance- (20% New / 10% Existing (2 points), -30% New / 20% Existing (2 points), -40% New / 30% Existing(2 points), -50% New / 40% Existing (2 points), -60% New / 50% Existing (2 points), and 1 point each for Renewable Energy-5%, Renewable Energy-10%, Renewable Energy- 20%, Additional Commissioning, Ozone Depletion, Measurement & Verification, and Green Power.

Materials & Resources

This category concentrates on judicial use of green and sustainable materials and achieving a more sustainable building. This contributes in reducing the rate of depletion of natural resources and increasing the indoor environmental quality of the building (Cryer, Felder, Matthews, Okrent, Pettigrew, 2006). Studies suggest that good indoor environmental quality results in higher occupancy rates of the building and better productivity of the occupants of the building.

With one perquisite termed as Storage & Collection of Recyclables, it has thirteen other points which can be pursued to get a LEED rating. These points are Building Reuse-Maintain 75% of Existing Shell, Building Reuse-Maintain 100% of Shell, Building Reuse-Maintain 100% Shell & 50% Non-Shell, Construction Waste Management-Divert 50%, Construction Waste Management-Divert 75%, Resource Reuse-Specify 5%, Resource Reuse-Specify 10%, Recycled Content-Specify 25%, Recycled Content-Specify 50%, Local/Regional Materials-20% Manufactured Locally, Local/Regional Materials-of 20% Above, 50% Harvested Locally, Rapidly Renewable Materials, and Certified Wood.

Indoor Environmental Quality

This section of the requirements concentrates on achieving a healthier environment for the building occupant by use of green and low emitting materials, providing clean air and maintaining optimum thermal comfort. It concentrates on increasing air quality and optimizing ventilation, controlling air moisture and cleaning and purifying the air.

This section has two prerequisites known as Minimum IAQ Performance and Environmental Tobacco Smoke (ETS) Control. Other fifteen achievable credits are Carbon Dioxide Monitoring, Increase Ventilation Effectiveness, Construction IAQ Management Plan-During Construction, Construction IAQ Management Plan-Before Occupancy, Low-Emitting Materials-Adhesives & Sealants, Low-Emitting Materials-Paints, Low-Emitting Materials-Carpet, Low-Emitting Materials-Composite Wood, Indoor Chemical & Pollutant Source Control, Controllability of Systems-Perimeter, Controllability of Systems-Non-Perimeter, Thermal Comfort, Thermal Comfort-Permanent Monitoring System, Daylight & Views-Daylight 75% of Spaces and Daylight & Views-Views for 90% of Spaces.

Innovation & Design Process

Points in this section can be achieved by using innovative design, construction and operation techniques. This is considered to be the most flexible category of points (Cryer, Felder, Matthews, Okrent, Pettigrew, 2006). This also promotes new technologies and techniques to increase the knowledge about green and sustainable building systems.

In this section, one point is given for each innovation in design, up to a total of four points that can be achieved. Another achievable point is given if the design team consists of a LEED Accredited Professional thus completing 69 achievable points on a point checklist.

Some LEED rating points are easier to obtain because of the advantages they offer in terms of cost (Miranda, 2005). Professionals tend to pursue such points and neglect the points that are difficult to obtain. This may hamper the whole idea of LEED rating point systems, i.e. - to conserve the environment. The efficiency of LEED rating system could be significantly improved by focusing on these neglected points and direct them to focus more on environmental issues.

Research Methods

As previously mentioned, a similar paper topic by Cryer et al., (2006) used trend analysis with an unexplained methodology where 10 of the top and bottom preferred LEED rating points were identified and analyzed for LEED NC 2.0 and 2.1, where only253 projects were studied. This research not only increases the number of projects examined, but analyzes LEED NC 2.2 up–to-date projects. Precedent has been set for establishing 10% as the upper limit of trend analysis which is an acceptable practice in research (according to Naoum, 1998, and Liu and Fellows, 1997). Frequency of occurrences uses an interval scale from the set of measurement scales (nominal, ordinal, interval and ratio). Interval scale

assumes that the distance of types between scores is the same. For example, a project that achieves a particular LEED rating on a point is the same as a different project that achieves the same point. This type of interval scale uses a nominal level where there is no rank of priority. This research is therefore based on a quantitative approach where factual data is gathered to study the relationship between facts and frequency of occurrences according to the practice of trend analysis as found in the precedent frequency study. Analysis of this data yields quantified results of actual point avoidance from which conclusions can be derived of implied in the light of theory and practice.

The objective of this research is to find out the less preferred LEED rating points which will help to locate the bottlenecks in the LEED rating system and give vital information that can help improving the LEED rating system. This will be done by studying all the LEED NC rating projects with respect to the points pursued for achieving the desired level of LEED rating and analyzing the existing point usage trends. The most important issue is to find out the valuable information about this case from all the information sources available and use that to project the future opportunities in terms of improving the system. There are a number of ways to address these types of issues. Trend Analysis is one such technique that is well tested and gives reliable outputs. Trend Analysis is about collecting and analyzing data relevant to the study. Based on the analysis of the trends, research scholars can predict the behavior of the subject or issue under study in the future (Wallace, 2005)

The research methodology for this study has been divided into three phases:
Phase I- Data Collection: USGBS had provided the LEED point check-lists of all the projects rated by LEED on the USGBC web site in the form of case studies. The information about the projects and their LEED point check-list is in the form of Portable Document Format (PDF) files that can be viewed or downloaded. Until August 1st, 2008, there were 1,005 project checklists available; out of these, the information about 149 projects was not retrievable because of the incomplete individual project information. The total number of projects studied for this research is 856 which represents 85.2% of the total number of projects listed. Each PDF file was downloaded and studied, and each point achieved in the project checklist was put in a work sheet. The whole data comprised of these work sheets and was categorized on the bases of level of certification and LEED NC version used to keep the data organized and manageable.

Phase II- Data Analysis: In the second phase, the collected data was studied and analyzed for any point usage trends. Using the data work sheets, the frequency of usage of each LEED rating point was determined, which helped in finding out the existing point usage patterns. The frequency of points used was studied with and without the consideration of level of rating to understand the effect of level of rating on the usage pattern of points.

Phase III- Conclusion: After the analysis of the data, a clear trend of point usage was observed which indicated that there are some points that are preferred over other and highlighted the LEED rating points that are not pursued in most projects. The rating points used in less than 10% of the projects were shortlisted and observed.

Data Analysis

In order to identify and analyze the LEED certification points that are not pursued, out of a total of 1,005 LEED rated projects, 856 projects were retrievable and were studied and used as the research database. This data was collected from the USGBC website. USGBC has record of all the project checklists that were rated under LEED. To make the data collection more systematic and convenient, this data collection was divided into 3 parts mainly as data from LEED NC V2.0, LEED NC V2.1 and LEED NC V2.2. Furthermore, each Version of LEED NC was divided into the four certification categories of certified, silver, gold and platinum. All the LEED point checklists were studied and a comprehensive work sheet was made to study the points less preferred and preferred for achieving LEED rating.

Analysis of projects rated under LEED NC V 2.0

LEED NC 2.0 was first launched by USGBC in 1999. There are four level of LEED certification starting with LEED Certified which requires a project to achieve 26 to 32 points, LEED Silver with 33 to 38 points, LEED Gold with 39 to 51 points and the LEED Platinum with 52 to 69 points. With LEED NC V2.0, a total of 261 buildings were rated using this version. When these buildings were studied in terms of the points pursued, it was seen that some points are preferred over other points for reasons related to cost, time, feasibility and quality. Following is the graphical representation showing the relation of points pursued and the frequency of their use:

LEED NC V2.0 - Certified projects

In LEED NC version 2.0, 98 buildings were rated as LEED Certified. Figure 19 in Appendix-A shows the usage of points in achieving LEED Certified rating and Figure 7 shows the percentage use of points that were used in less than 10% projects.

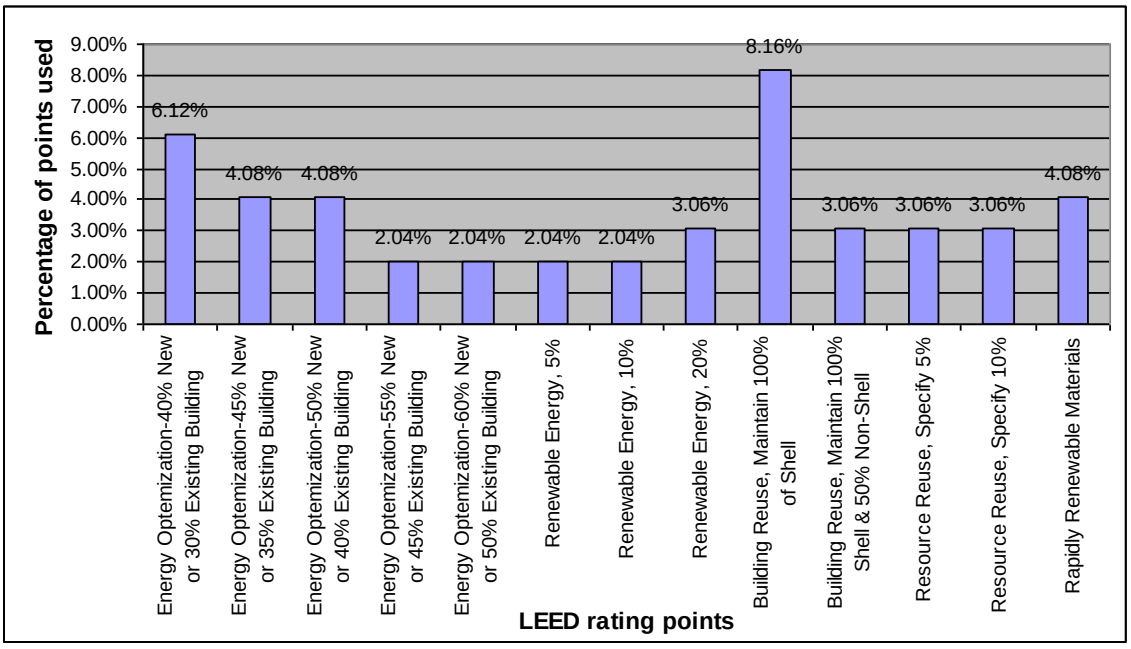

Figure 7: Percentage use of points used in less than 10% of LEED 2.0 Certified projects.

LEED NC V2.0 Silver rated projects

In LEED NC version 2.0, 76 were rated as LEED Silver. Figure 20 in Appendix-A shows the usage of points in achieving LEED Silver rating and Figure 8 shows the percentage use of points that were used in less than 10% projects. Points that were pursued in less than 10 % of the projects are:

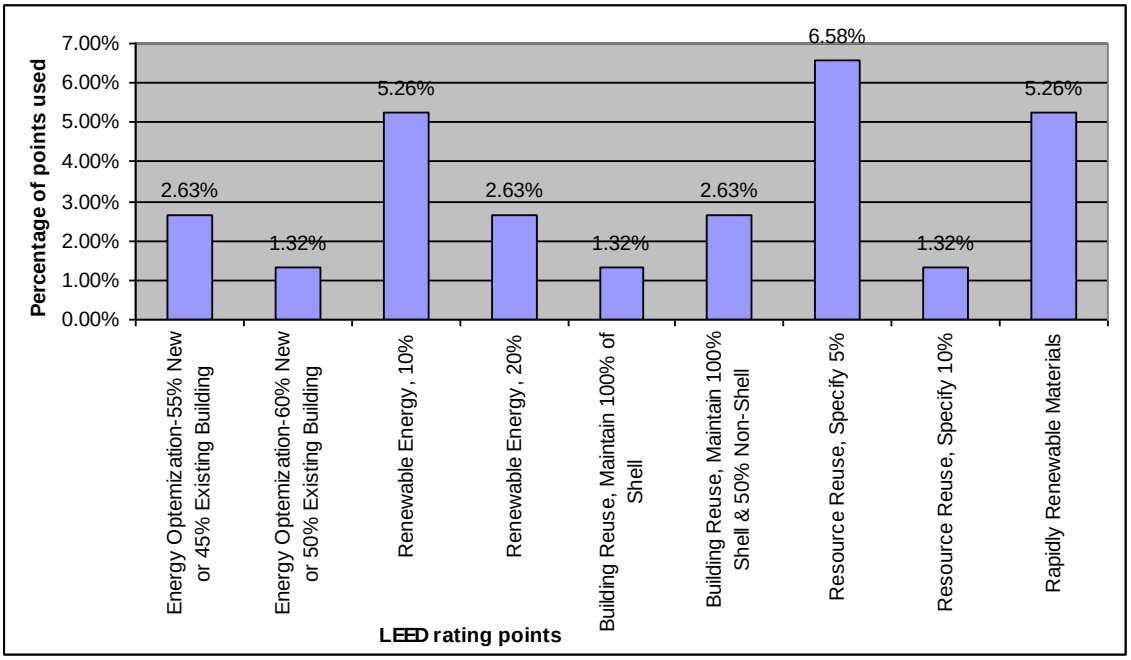

Figure 8: Percentage use of points used in less than 10% of LEED 2.0 Silver projects.

LEED NC V2.0 Gold rated projects

In LEED NC version 2.0, 75 were rated as LEED Gold. Figure 20 in Appendix-A shows the usage of points in achieving LEED Gold rating and figure 9 shows the percentage use of points that were used in less than 10% projects. Points that were pursued in less than 10 % of the projects are:

1. Building Reuse, Maintain 75% of Existing Shell
2. Credit 1.2 Building Reuse, Maintain 100% of Shell
3. Credit 1.3 Building Reuse, Maintain 100% Shell & 50% Non-Shell
4. Resource Reuse, Specify 10%

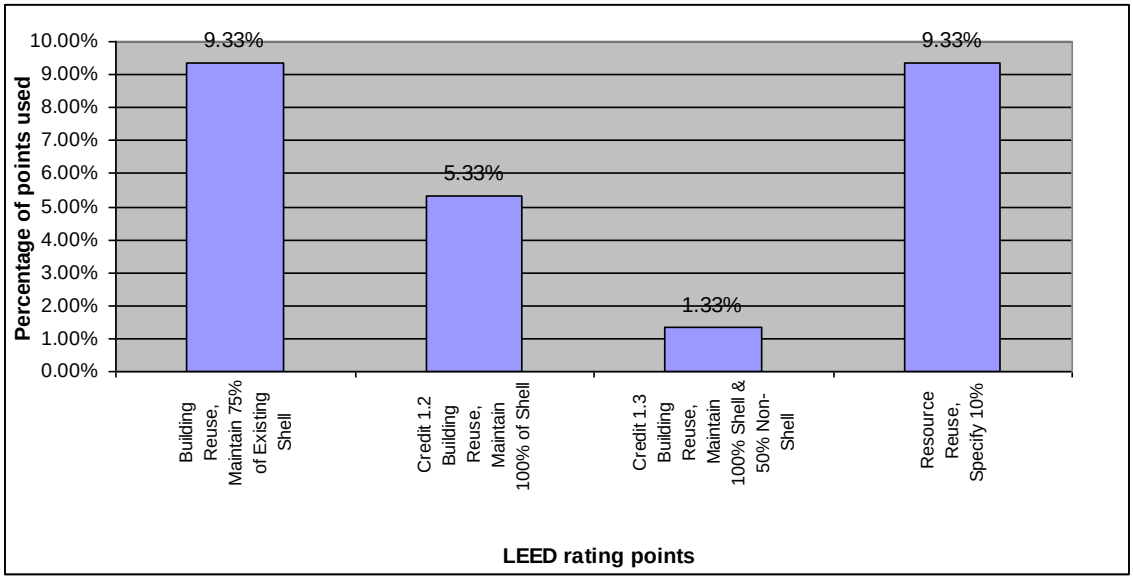

Figure 9: Percentage use of points used in less than 10% of LEED 2.0 Gold projects.

LEED NC 2.0 Platinum rated projects

In LEED NC version 2.0, 12 buildings were rated as LEED Platinum. Figure 21 in Appendix-A shows the usage of points in achieving LEED Platinum rating and figure 10 shows the percentage use of points that were used in less than 10% projects.

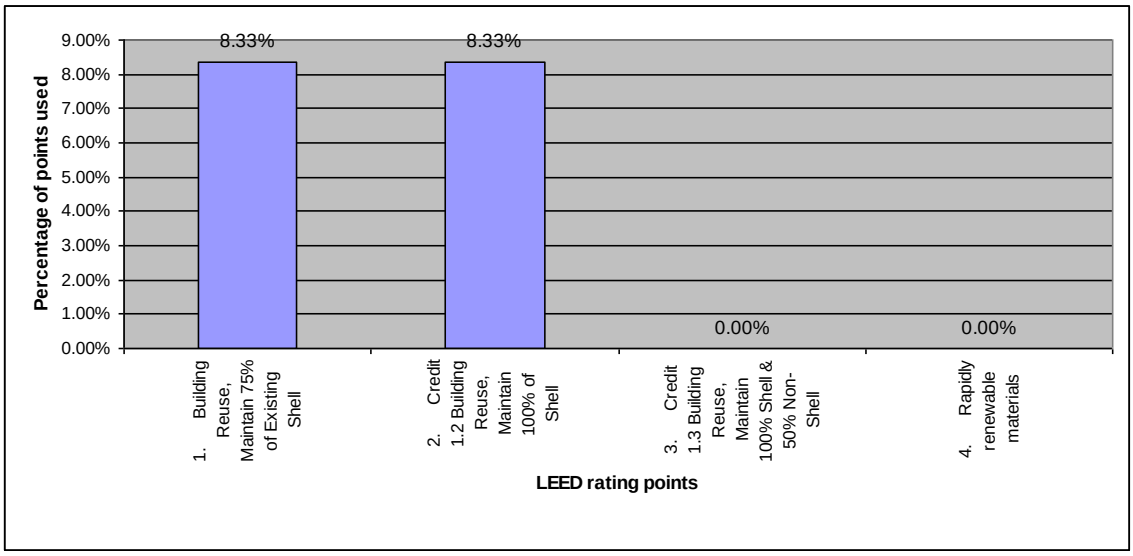

Figure 10: Percentage use of points used in less than 10% of LEED 2.0 Platinum projects.

LEED NC 2.0 all levels: Pattern of usage of points irrespective to the level of rating

In LEED NC version 2.0, a total of 261 buildings were rated and Figure 22 in Appendix-A shows the usage of points in achieving LEED Platinum rating and figure 10 shows the percentage use of points that were used in less than 10% projects. Points that were pursued in less than 10 % of the projects are:

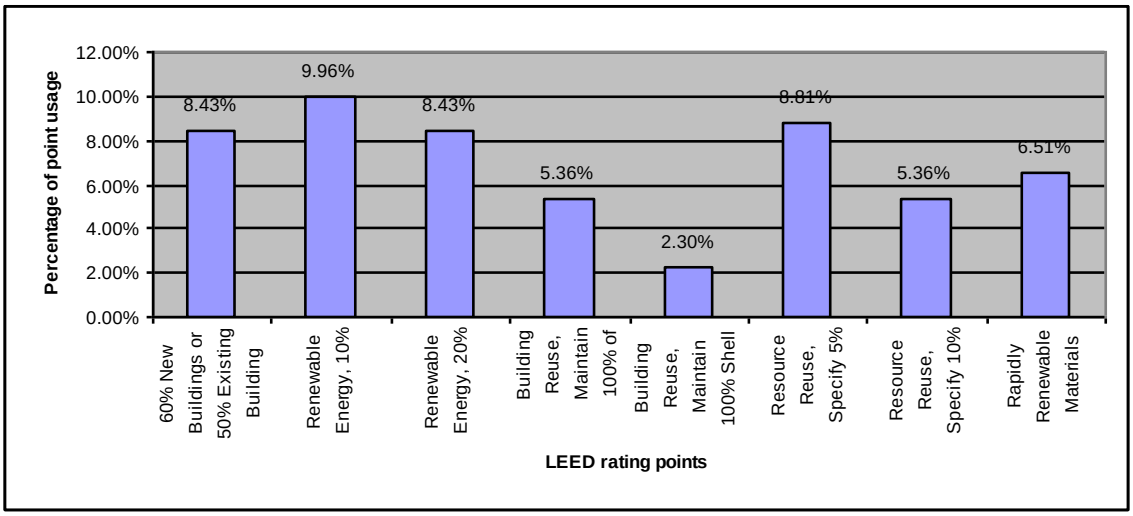

Figure 10: Percentage use of points used in less than 10% of projects rated by LEED2.0.

Analysis of projects rated under LEED NC V 2.1

LEED NC V 2.1 was first introduced in year 2000. Nearly 740 buildings were rated under this version of LEED NC. Out of these, 266 were rated as LEED Certified, 243 as LEED Silver, 195 as LEED Gold and 36 as LEED Platinum. Following is the graphical representation showing the relation of points pursued and the frequency of their use:

LEED NC V 2.1 Certified projects

In LEED NC version 2.1, a total of 266 buildings were rated as LEED Certified. Figure 23 in Appendix-A shows the usage of points in achieving LEED Certified rating and figure 12 shows the percentage use of points that were used in less than 10% projects.

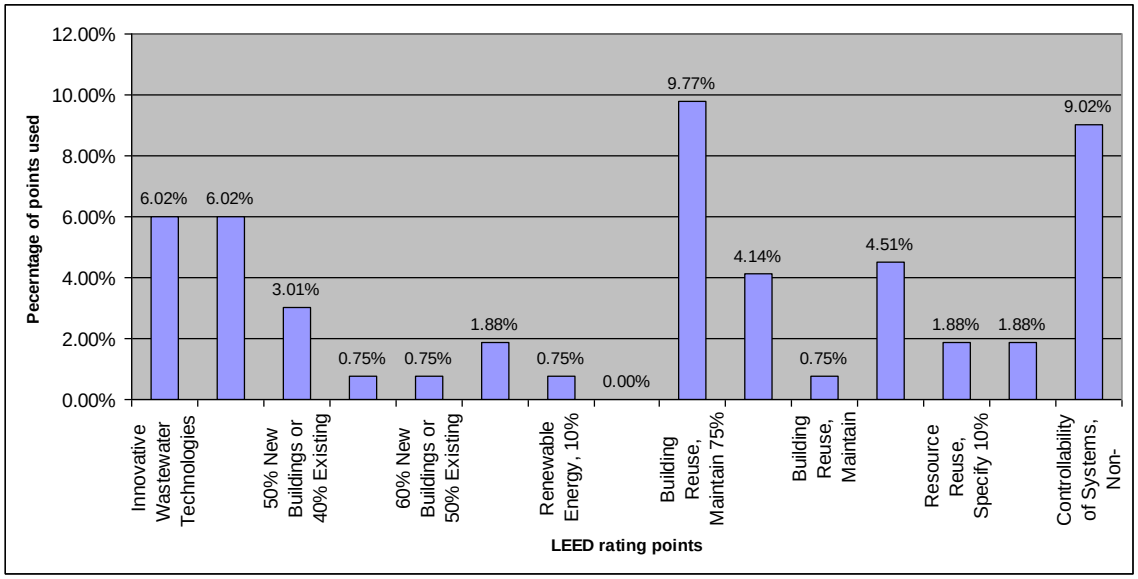

Figure 12: Percentage use of points used in less than 10% of LEED 2.1 Certified projects.

LEED NC V 2.1 Silver rated projects

In LEED NC version 2.1, a total of 243 buildings were rated as LEED Silver. Figure 24 in Appendix-A shows the usage of points in achieving LEED Silver rating and figure 13 shows the percentage use of points that were used in less than 10% projects.

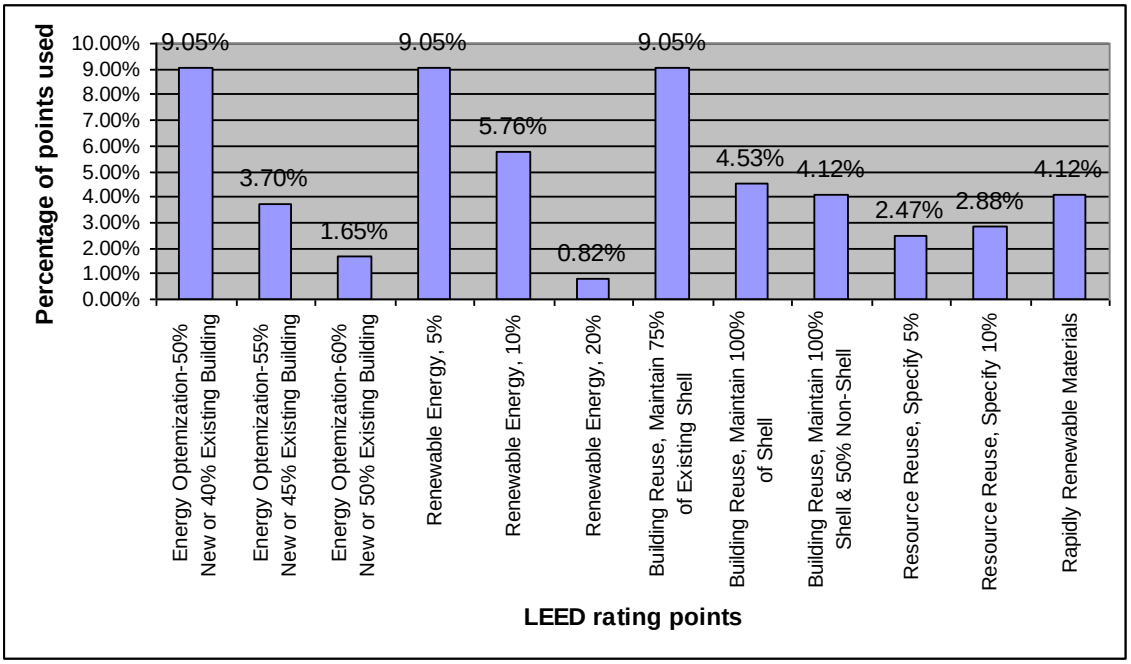

Figure 13: Percentage use of points used in less than 10% of LEED 2.1 Silver projects.

LEED NC V 2.1 Gold rated projects

In LEED NC version 2.1, a total of 195 buildings were rated as LEED Gold. Figure 25 in Appendix-A shows the usage of points in achieving LEED Gold rating and figure 14 shows the percentage use of points that were used in less than 10% projects.

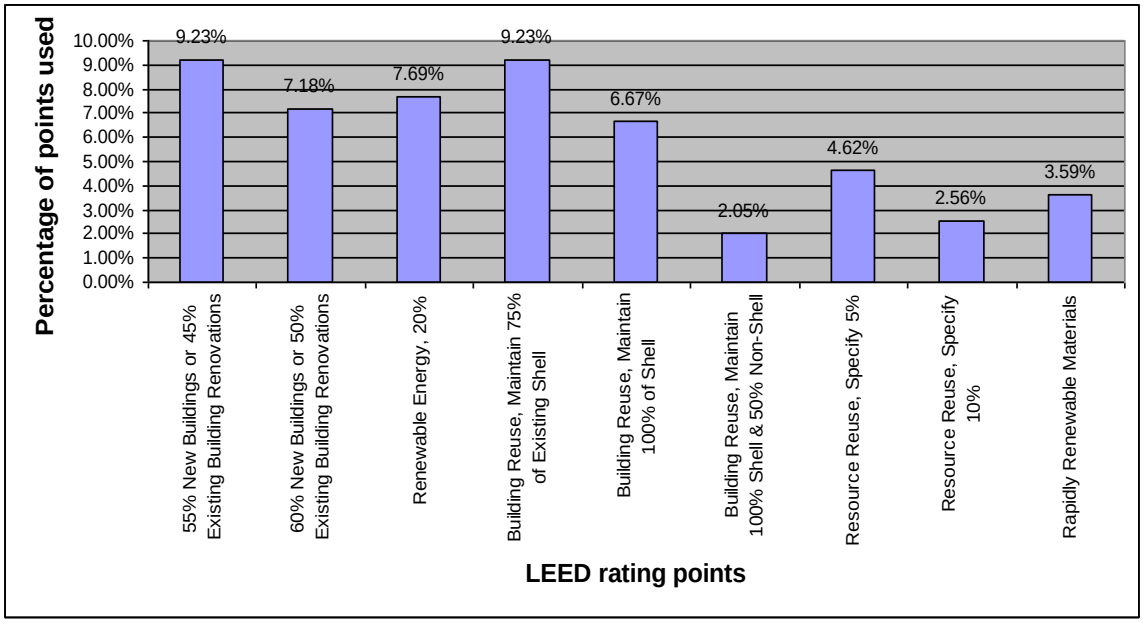

Figure 14: Percentage use of points used in less than 10% of LEED 2.1 Gold projects.

LEED NC V 2.1 Platinum rated projects

In LEED NC version 2.1, a total of 36 buildings were rated as LEED Platinum. Figure 26 in Appendix-A shows the usage of points in achieving LEED Platinum rating and figure 15 shows the percentage use of points that were used in less than 10% projects.

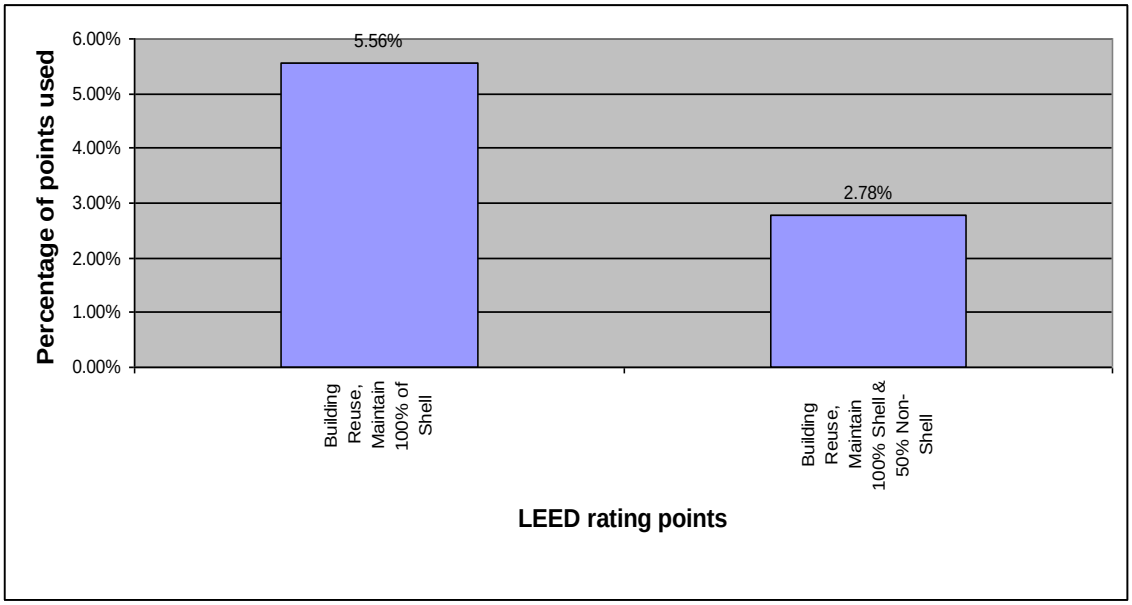

Figure 15: Percentage use of points used in less than 10% of LEED 2.1 Platinum projects.

LEED NC 2.1 all levels: Pattern of usage of points irrespective to the level of rating

In LEED NC version 2.1, a total of 740 projects were rated. Figure 27 in Appendix-A shows the usage of points in achieving LEED Platinum rating and figure 16 shows the percentage use of points that were used in less than 10% projects.

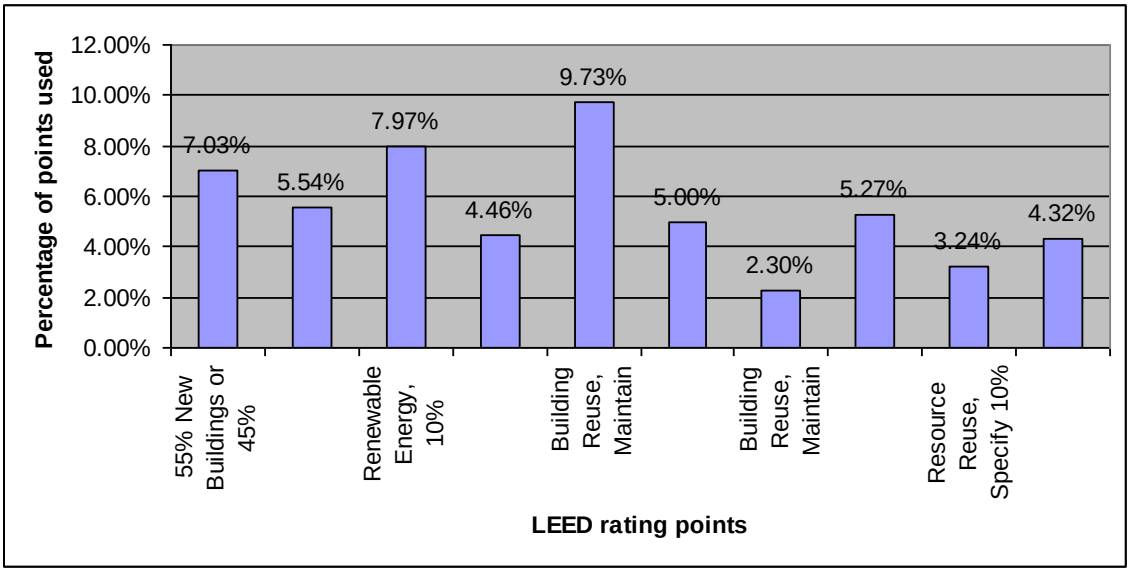

Figure 16: Percentage use of points used in less than 10% of projects rated by LEED 2.1.

Analysis of projects rated under LEED NC V 2.2

LEED NC V 2.2 was first introduced in year 2002. By August 1st 2008, nearly 90 buildings were rated under this version of LEED NC. Out of 90, information about 38 buildings was retrieved. Out of 38 projects retrieved, 10 were rated as LEED Certified, 18 as LEED Silver, 8 as LEED Gold and 2 as LEED Platinum and following is the graphical representation showing the relation of points pursued and the frequency of their use:

LEED NC V 2.2 Certified projects

In LEED NC version 2.2, a total of 10 Buildings were rated as LEED Certified till August 1st 2008. Figure 28 in Appendix-A shows the usage of points in achieving LEED Certified rating.

LEED NC V 2.2 Silver rated projects

In LEED NC version 2.2, a total of 18 Buildings were rated as LEED Silver till August 1st 2008. Figure 29 in Appendix-A shows the usage of points in achieving LEED Silver rating and figure 17 shows the percentage use of points that were used in less than 10% projects.

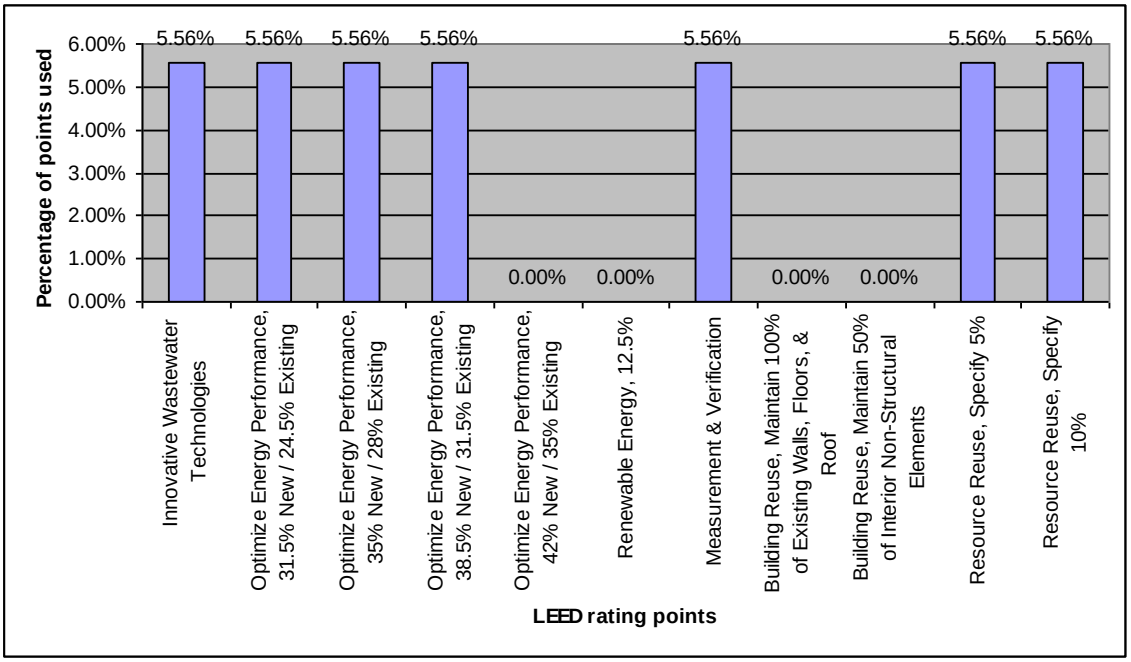

Figure 17: Percentage use of points used in less than 10% of LEED 2.1 Silver projects.

LEED NC V 2.2 Gold rated projects

In LEED NC version 2.2, a total of 8 Buildings were rated as LEED Gold. Figure 30 in Appendix-A shows the usage of points in achieving LEED Gold rating.

LEED NC V 2.2 Platinum rated projects

In LEED NC version 2.2, a total of 2 Buildings were rated as LEED Platinum. Figure 31 in Appendix-A shows the usage of points in achieving LEED Platinum rating.

LEED NC 22 all levels: Pattern of usage of points irrespective to the level of rating

In LEED NC version 2.2, a total of 38 projects were rated till August 1st 2008 and Figure 32 in Appendix-A shows the usage of points in achieving LEED Platinum rating and figure 18 shows the percentage use of points that were used in less than 10% projects.

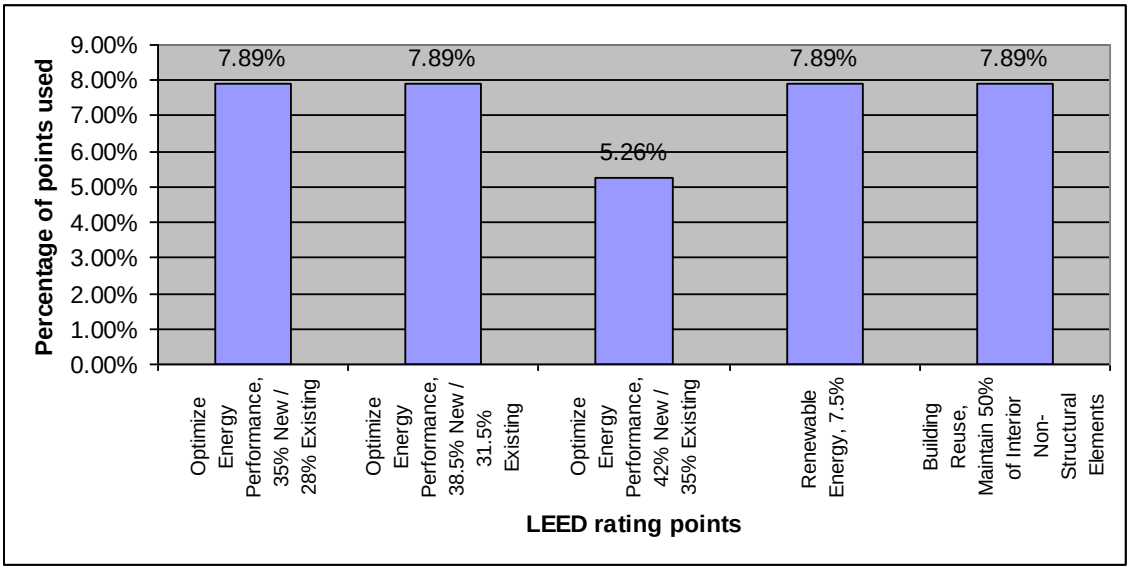

Figure 18: Percentage use of points used in less than 10% projects rated by LEED 2.2.

Conclusions

Table 1: LEED rating points used in less than 10% of projects with respect to the level of rating and LEED NC version

LEED Rating Points	LEED NC 2.0				LEED NC 2.1				LEED NC 2.2			
	C	S	G	P	C	S	G	P	C	S	G	P
Reduce Site Disturbance, Protect or Restore Habitat									X			
Innovative Wastewater Technologies					X				X	X		
40% New Buildings or 30% Existing Building Renovations	X											
45% New Buildings or 35% Existing Building Renovations	X				X					X		
50% New Buildings or 40% Existing Building Renovations	X				X	X			X	X		
55% New Buildings or 45% Existing Building Renovations	X	X			X	X	X		X	X		
60% New Buildings or 50% Existing Building Renovations	X	X			X	X	X		X	X		
Renewable Energy, 5%	X				X	X					X	
Renewable Energy, 10%	X	X			X	X					X	

Renewable Energy, 20%	X	X			X	X	X			X	X	
Measurement & Verification										X		
Building Reuse, Maintain 75% of Existing Shell			X	X	X	X	X					
Building Reuse, Maintain 100% of Shell	X	X	X	X	X	X	X	X	X	X		
Building Reuse, Maintain 100% Shell & 50% Non-Shell	X	X	X	X	X	X	X	X	X	X		X
Resource Reuse, Specify 5%	X	X			X	X	X		X	X	X	X
Resource Reuse, Specify 10%	X	X	X		X	X	X		X	X	X	X
Rapidly Renewable Materials	X	X	X	X	X	X	X				X	X
Controllability of Systems- Non-Perimeter					X							

From the data analysis done above, it is evident that there are some points that are less pursued as compared to others. There is a total of 18 rating points which are used in less that 10 percent of projects if the level of certification and LEED version is considered but if the levels of certification are considered it is not the number which truly represents the less preferred points in the LEED credit list. Since, the lower level of LEED ratings including LEED Certified and LEED Silver require only 26-32 and 33-38 points respectively, a large set of points remains unused i.e. the set of 10 percent of less preferred points include a larger number of points. On the other hand, in case of LEED Gold and LEED Platinum which require 39-51 and 52 to 69 points respectively, there is a scope of smaller number of points being left out i.e. the set of 10 percent of less preferred points will have lesser number points. Considering this pattern of points, the points that are truly less pursued to get LEED rating (irrespective to the level of rating) should be the points that are pursued in less than 10 percent of LEED Gold and LEED Platinum rated project.

Summarizing the research findings, Table 1 shows the LEED rating points used in less than 10% of projects with respect to the level of rating and LEED NC version, Table 2 shows the LEED rating points used in less than 10% of projects with respect to the level of rating and irrespective to the level version of LEED NC and Table 3 shows the List, frequency and percentage use of LEED rating points used in less than 10% of projects irrespective to the level of rating or LEED NC version used

Table 2: LEED rating points used in less than 10% of projects with respect to the level of rating and irrespective to the level version of LEED NC

LEED rating credits	**Level of LEED ratings**			
	Certified	Silver	Gold	Platinum
Reduce Site Disturbance, Protect or Restore Habitat	**X**			
Innovative Wastewater Technologies	**X**	**X**		
40% New Buildings or 30% Existing Building Renovations	**X**	**X**		

45% New Buildings or 35% Existing Building Renovations	X	X		
50% New Buildings or 40% Existing Building Renovations	X	X		
55% New Buildings or 45% Existing Building Renovations	X	X	X	
60% New Buildings or 50% Existing Building Renovations	X	X	X	
Renewable Energy, 5%	X	X	X	
Renewable Energy, 10%	X	X	X	
Renewable Energy, 20%	X	X	X	
Measurement & Verification		X		
Building Reuse, Maintain 75% of Existing Shell	X	X	X	X
Building Reuse, Maintain 100% of Shell		X	X	X
Building Reuse, Maintain 100% Shell & 50% Non-Shell	X	X	X	X
Resource Reuse, Specify 5%	X	X	X	X
Resource Reuse, Specify 10%	X	X	X	X
Rapidly Renewable Materials	X	X	X	X
Controllability of Systems- Non-Perimeter	X			

Table 3: List, frequency and percentage use of LEED rating points used in less than 10% of the total of 856 projects studied irrespective to the level of rating or LEED NC version used

LEED Rating points	**Frequency use**	**Percentage use**
55% New Buildings or 45% Existing Building Renovations	83	9.70%
60% New Buildings or 50% Existing Building Renovations	65	7.59%
Renewable Energy, 20%	57	6.66%
Building Reuse, Maintain 100% of Shell	59	6.89%
Building Reuse, Maintain 100% Shell & 50% Non-Shell	26	3.04%
Resource Reuse, Specify 5%	72	8.41%
Resource Reuse, Specify 10%	46	5.37%
Rapidly Renewable Material	54	6.31%

Future Work

As future work for this study, there is a scope of identifying and studying the reasons for not pursuing certain points towards the LEED rating of a building. Knowing these reasons can help fine tune the requirements for achieving these less preferred points.

The three major factors affecting a project are Cost, Time and Quality, understood by Kerzner (2000) as performance/technology. The cost of achieving a particular point is a major factor and can affect the decision of pursuing a point very easily. In case achieving a point is increasing the initial cost of construction by a considerable amount, no matter how much life cycle cost it can save, there is a high probability of that point being dropped from the list of preferred points. Similarly, if achieving a particular point requires a substantial amount time and affects the project schedule, the point might not be pursued in the end. In case of the factor of Quality, the point might not be pursued in case there is not much appreciable improvement in the performance of the building or the quality provided by a sustainable product or procedure option does not match the quality requirement of the project. There can be just one or a combination of more than one factor that can affect the decision of pursuing a particular point.

To determine the combination of factors and the importance of each factor affecting the pursuing of each point, a matrix can be developed and the importance of each factor can be rated from one (less important) to five (most important) using the Likert Scale. Likert Scale is a psychometric scale commonly used in surveys to determine the participant's level of agreement to a statement. It can also be put in terms of numbers and scoring can be done out of 5 or 7 points to determine the result. As future work for this study, each point can be taken one by one and can be studied to determine the factors and their importance in the decision process by looking at the LEED requirements for achieving that point. Refer to Appendix-C for a sample table and scale that can be used to rate these reasons using the Likert scale.

Significance of Study

The building sector offers a significant scope of improvement in the current energy conservation and carbon emission mitigation measures and policies. Building rating systems like LEED have been developed on the basis of extensive research. A fair evaluation of contemporary rating scenario shows that LEED is an established benchmark for the construction industry. It has been seen that some of the LEED points are preferred over others. This papers aims at studying the LEED credit points that are not pursued towards the rating of a project. After every few years, USGBC launches a new version of LEED rating systems. The outcomes of this study can also be used to assist USGBC to improve their rating systems.

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APPENDIX-A

Figure 19: LEED rating points pursued in LEED 2.0 for Certification of projects:

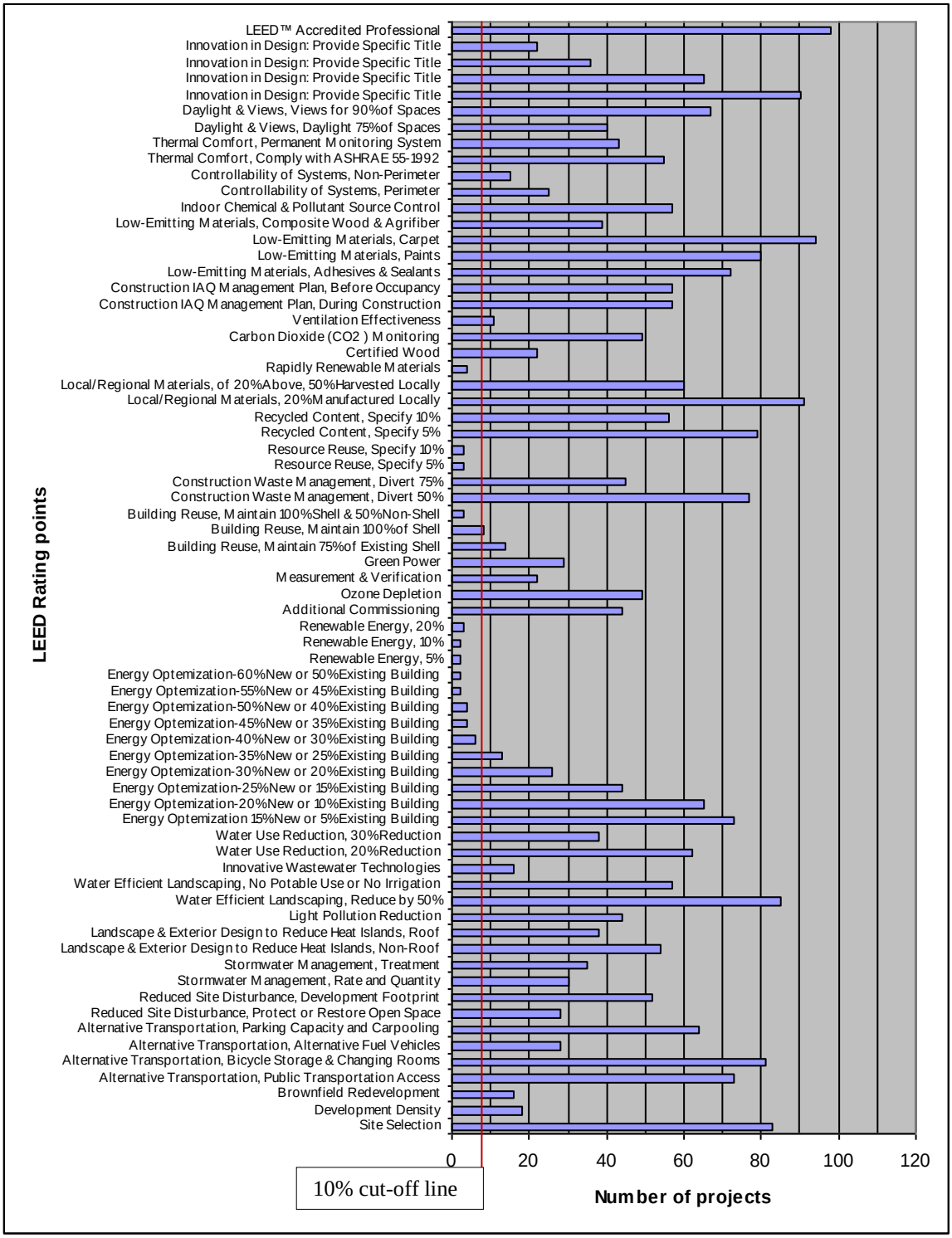


Figure 20: LEED rating points pursued in LEED 2.0 for Silver rating of projects

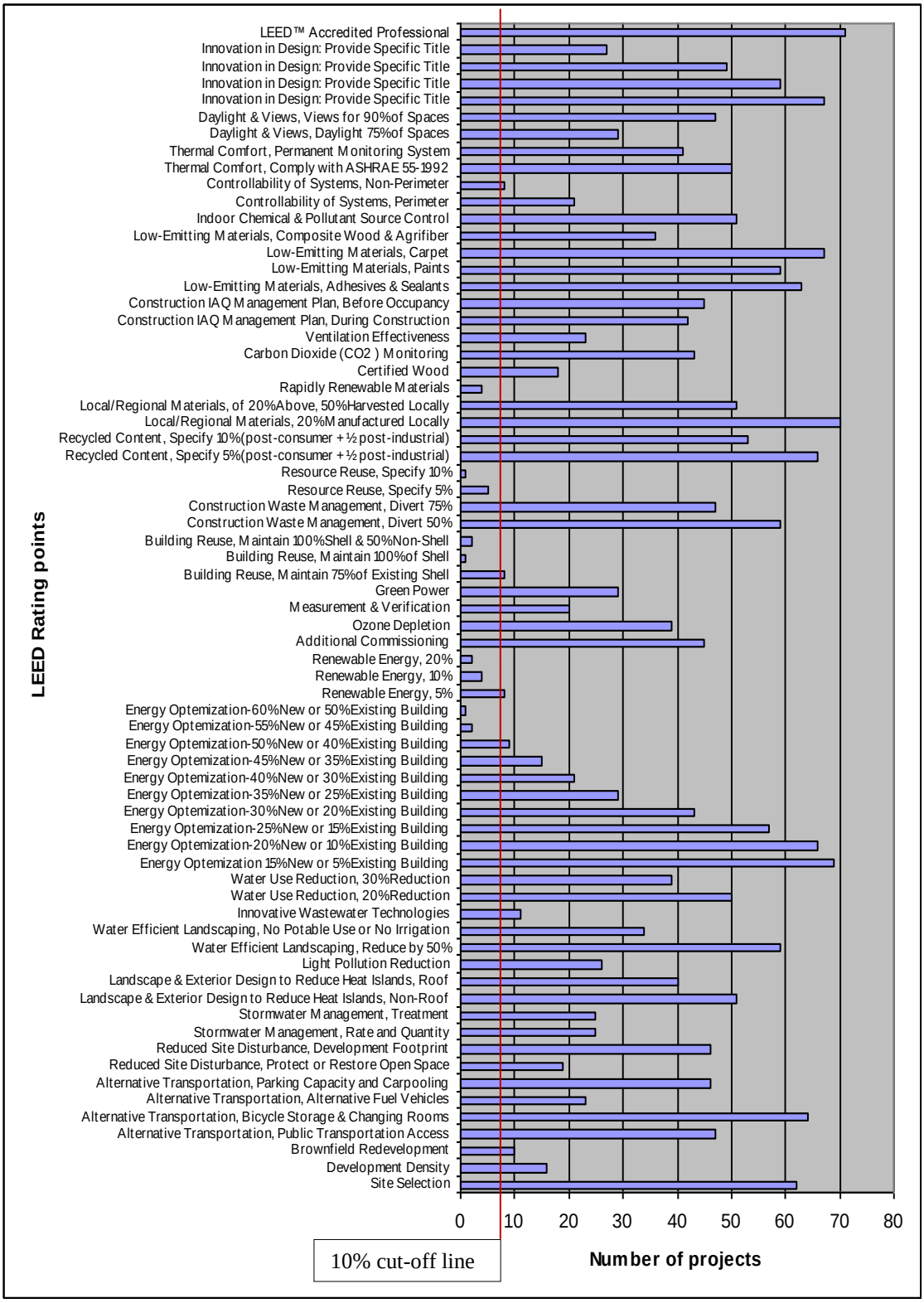


Figure 21: LEED rating points pursued in LEED 2.0 for a Gold rating of projects

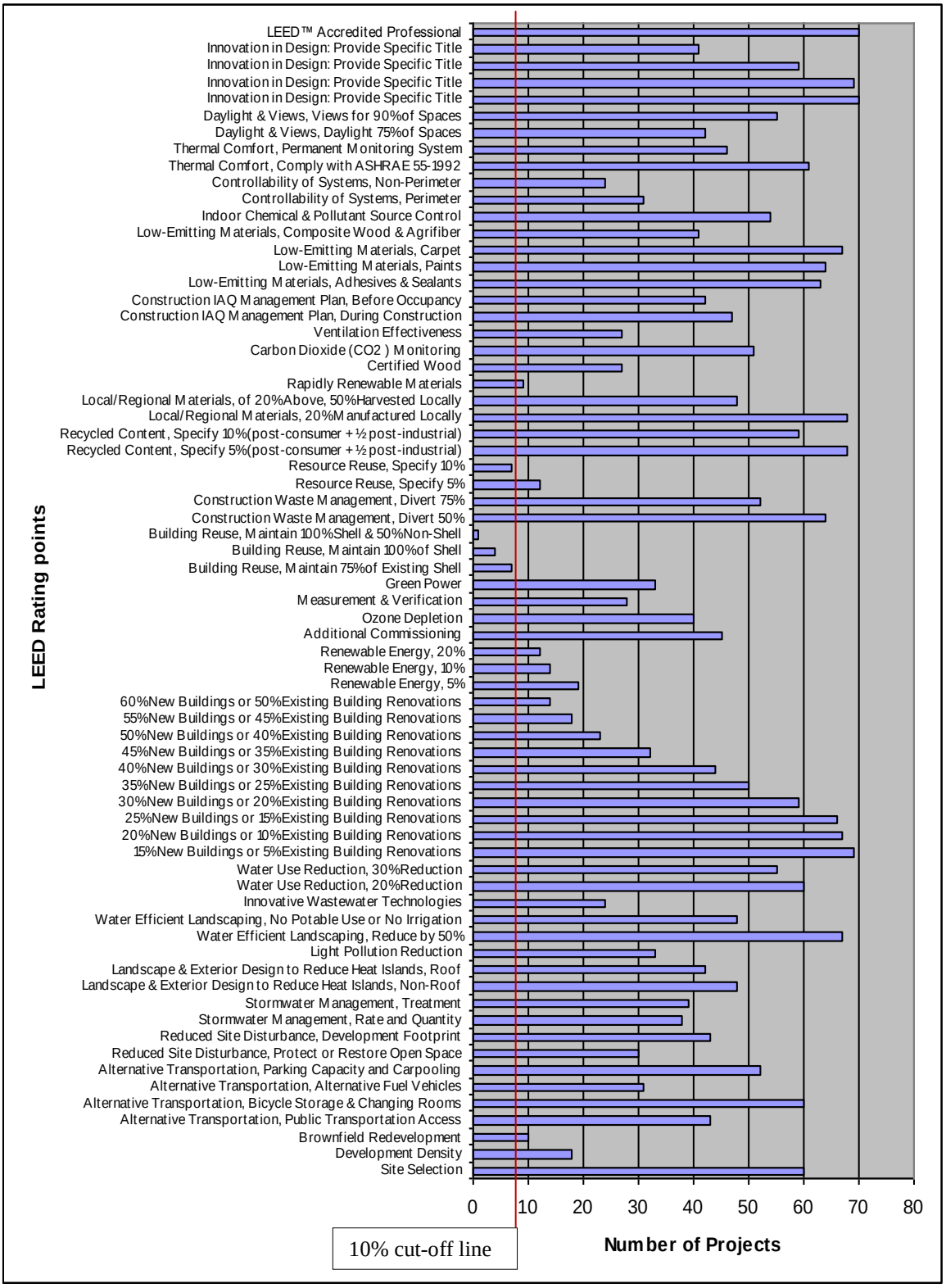


Figure 22: LEED rating points pursued in LEED 2.0 for a Platinum rating of projects

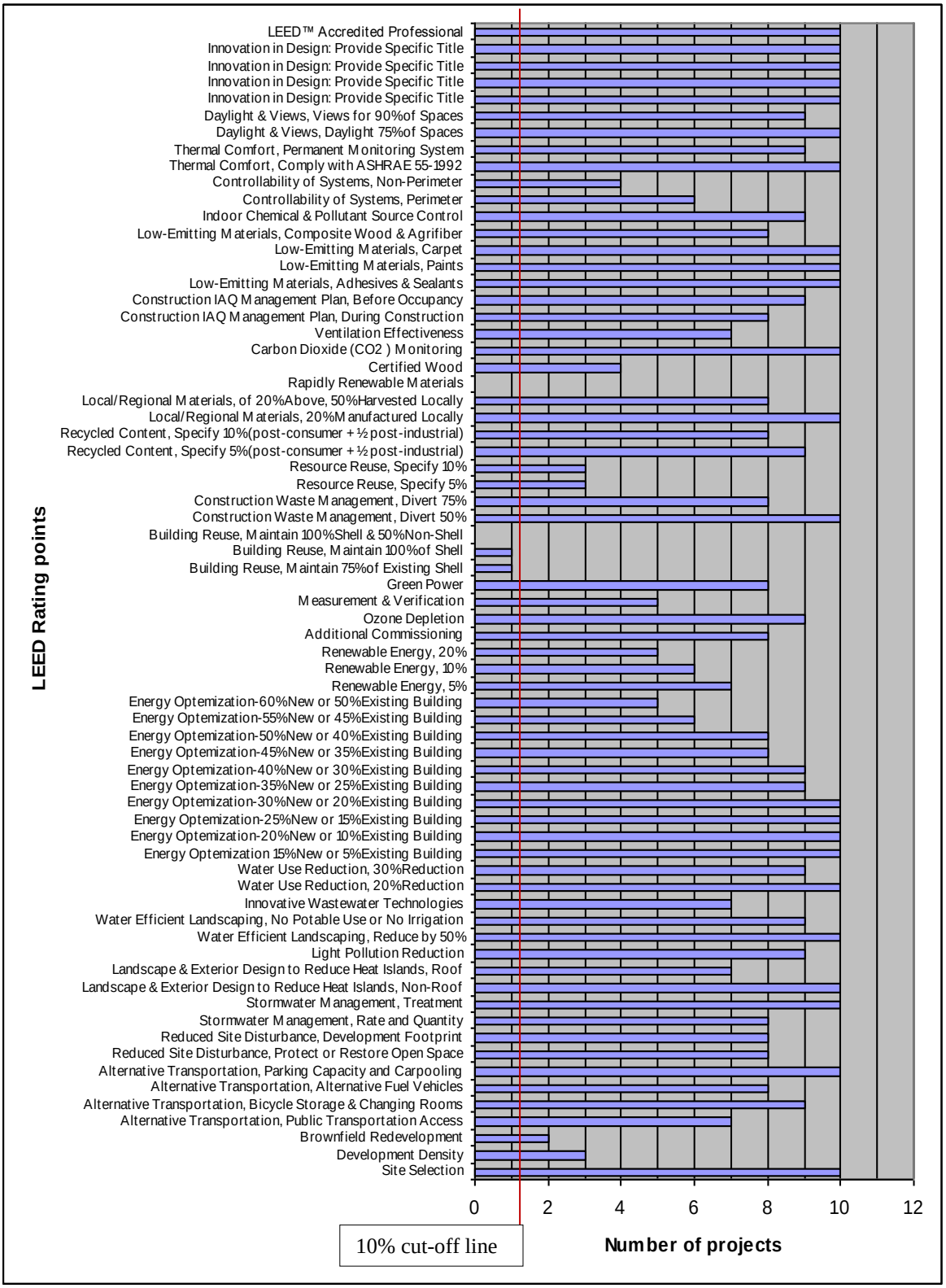


Figure 23: LEED rating points pursued in LEED 2.0 irrespective of level of rating

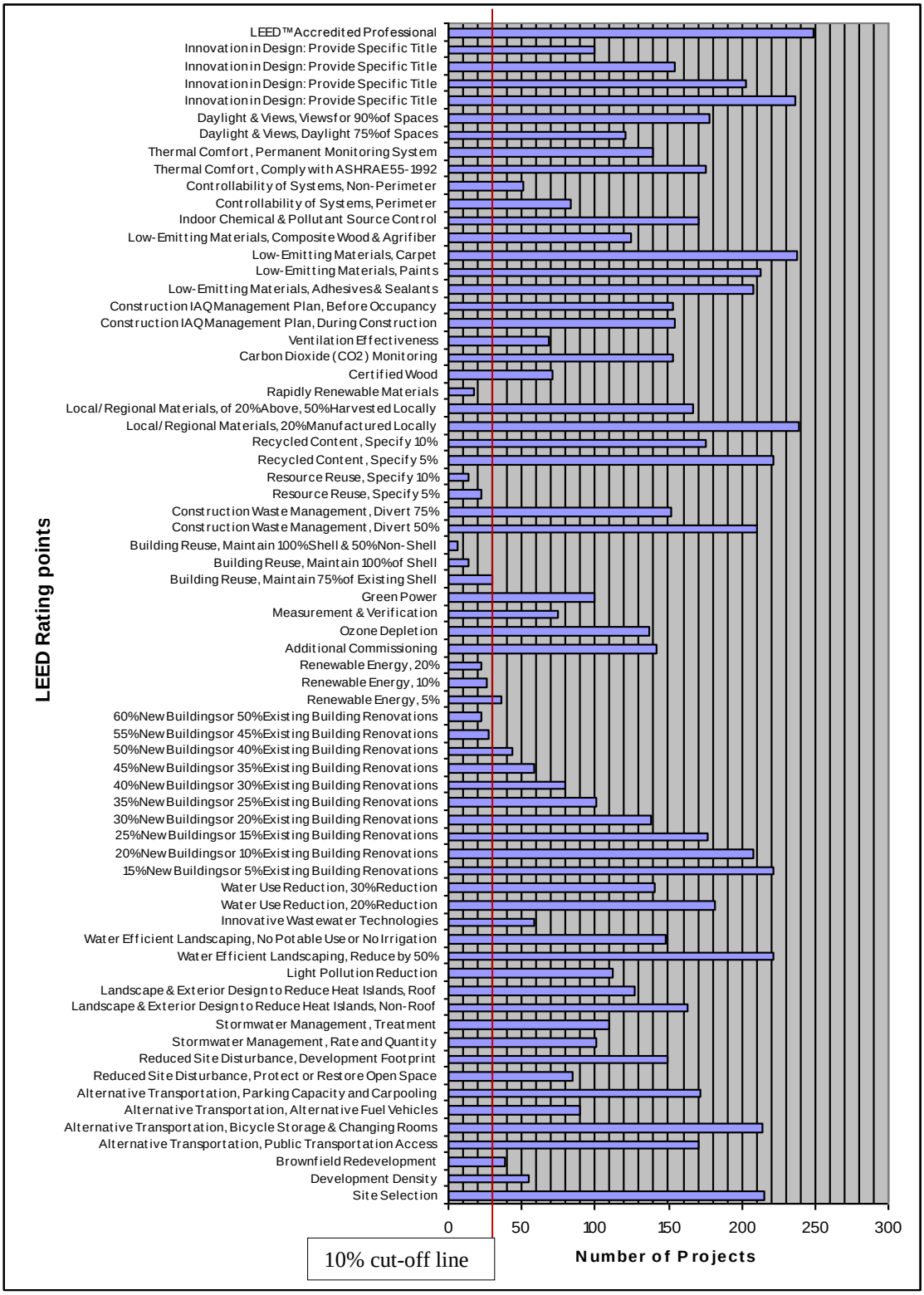


Figure 24: LEED rating points pursued in LEED 2.1 for Certification of projects

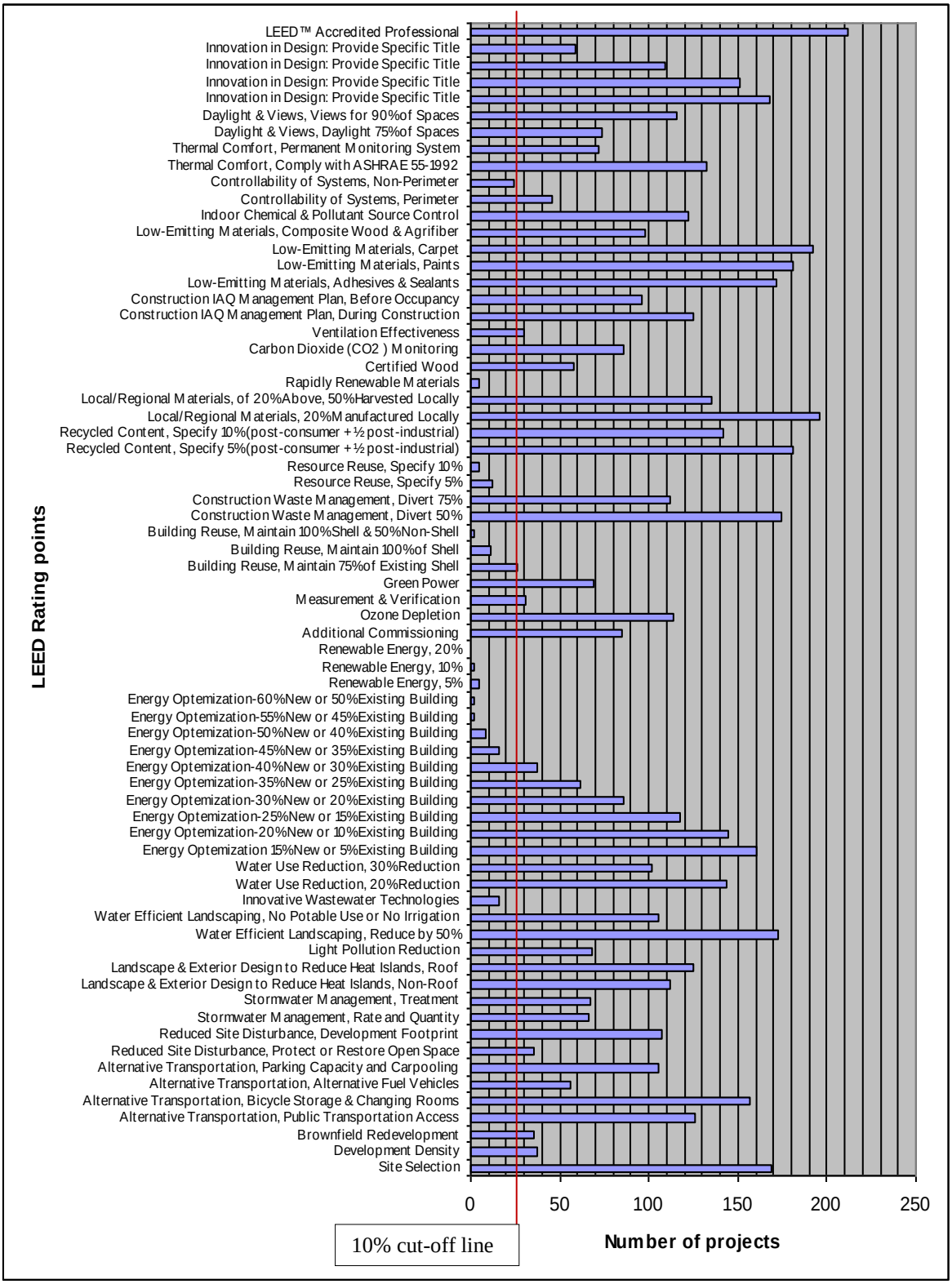


Figure 25: LEED rating points pursued in LEED 2.1 for a Silver rating of projects

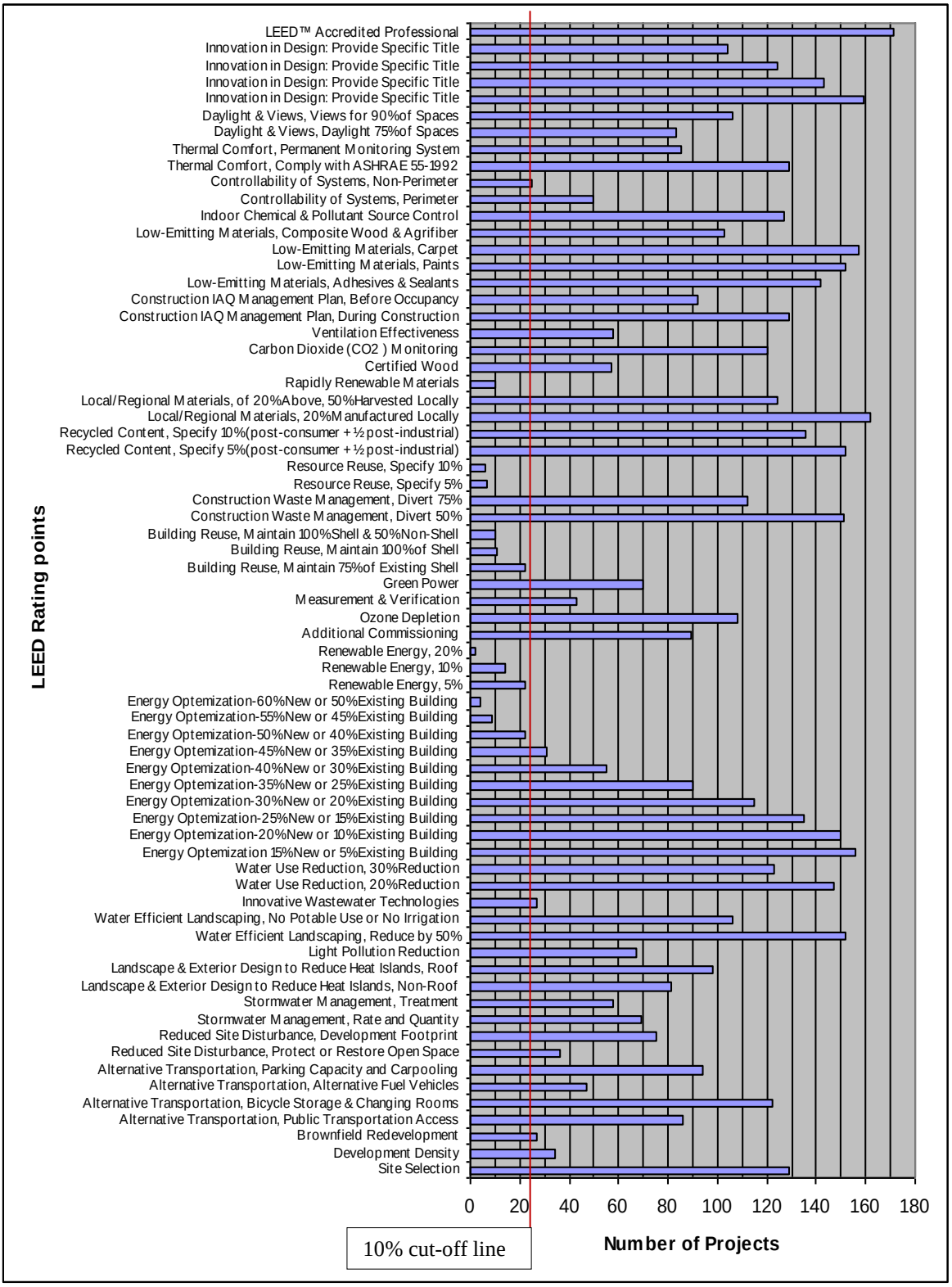


Figure 26: LEED rating points pursued in LEED 2.1 for a Gold rating of projects

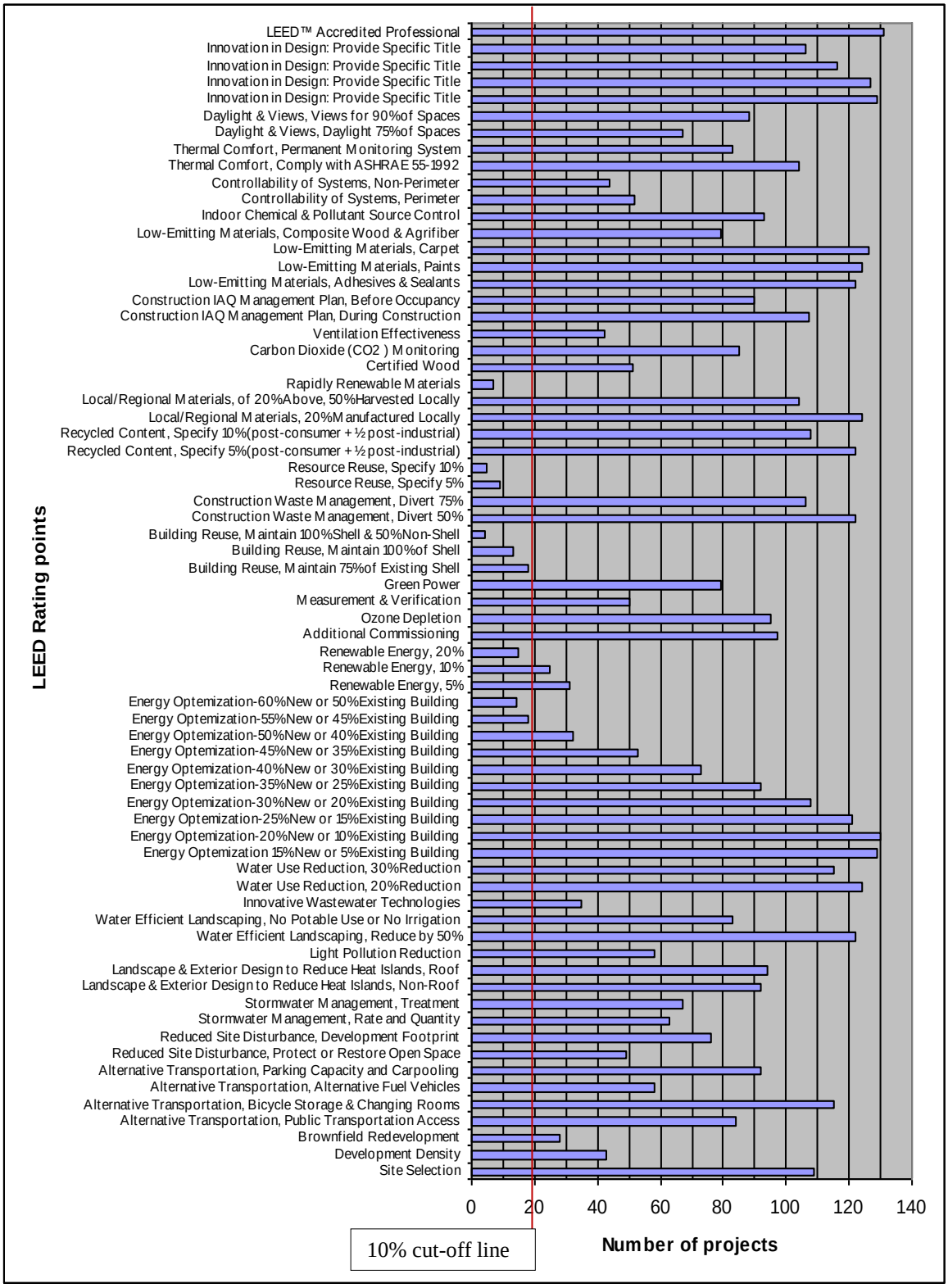


Figure 27: LEED rating points pursued in LEED 2.1 for a Platinum rating of project

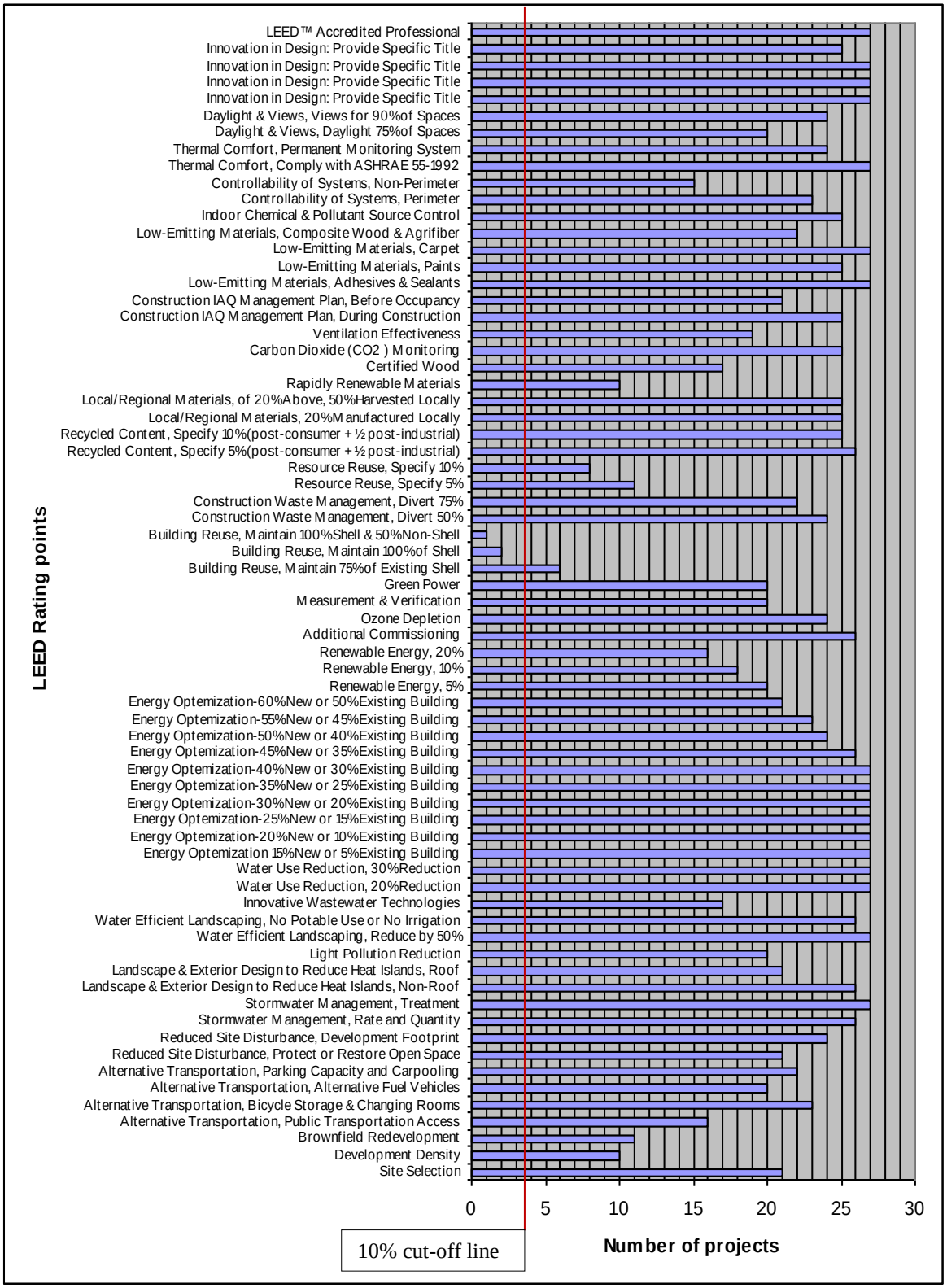


Figure 28: LEED rating points pursued in LEED 2.1 irrespective of level of rating

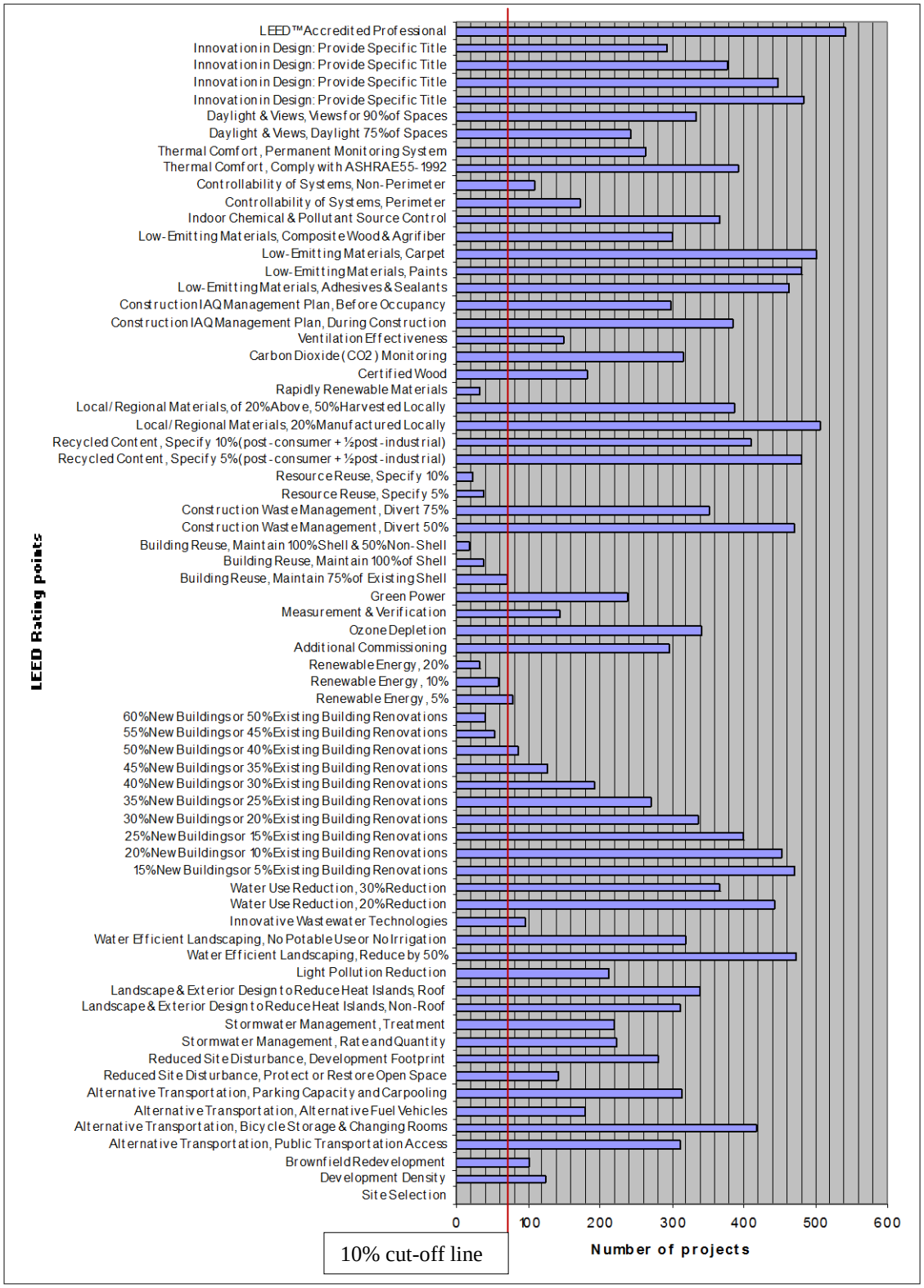


Figure 29: LEED rating points pursued in LEED 2.2 for Certification of projects

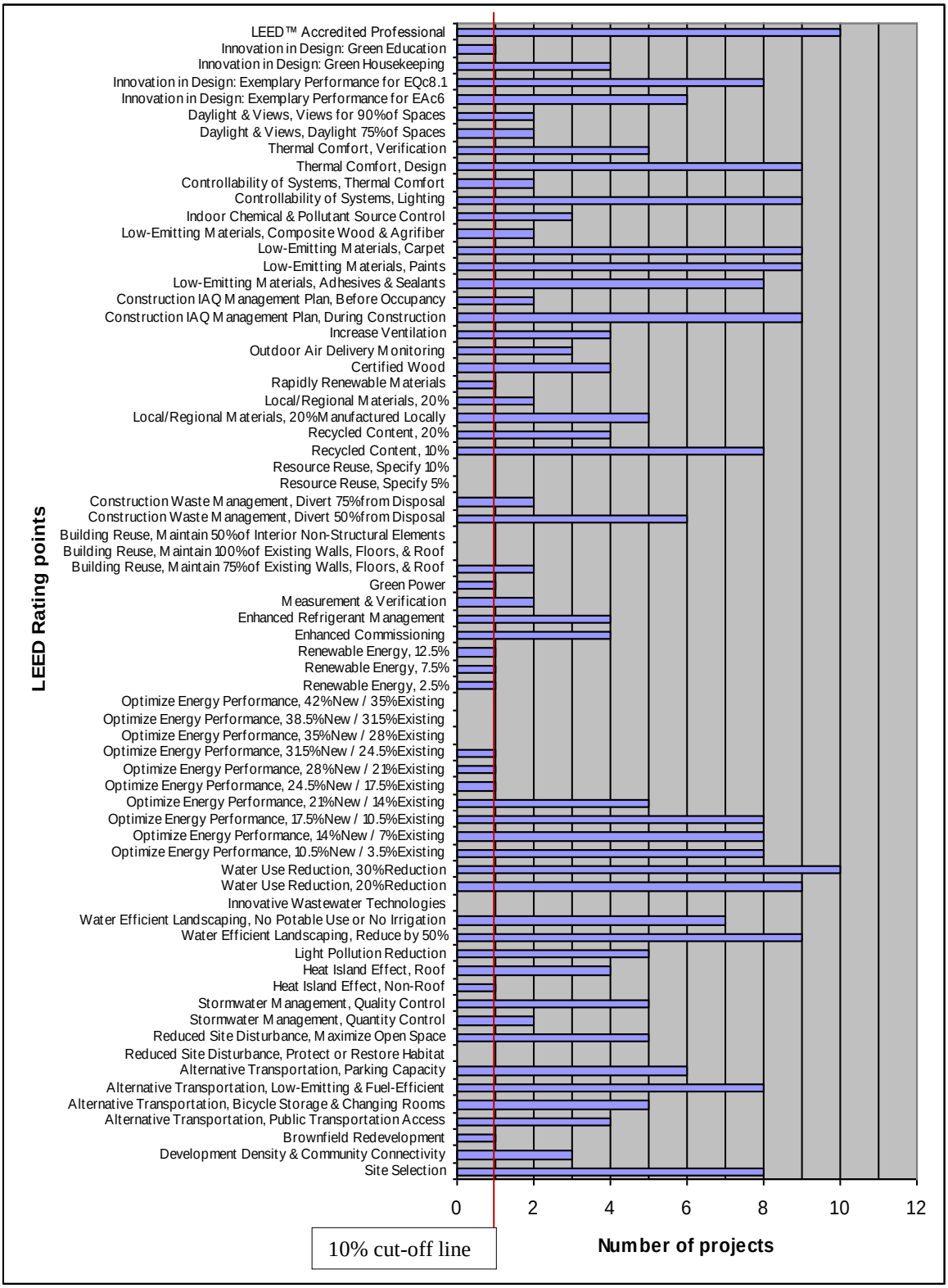


Figure 30: LEED rating points pursued in LEED 2.2 for a Silver rating of projects

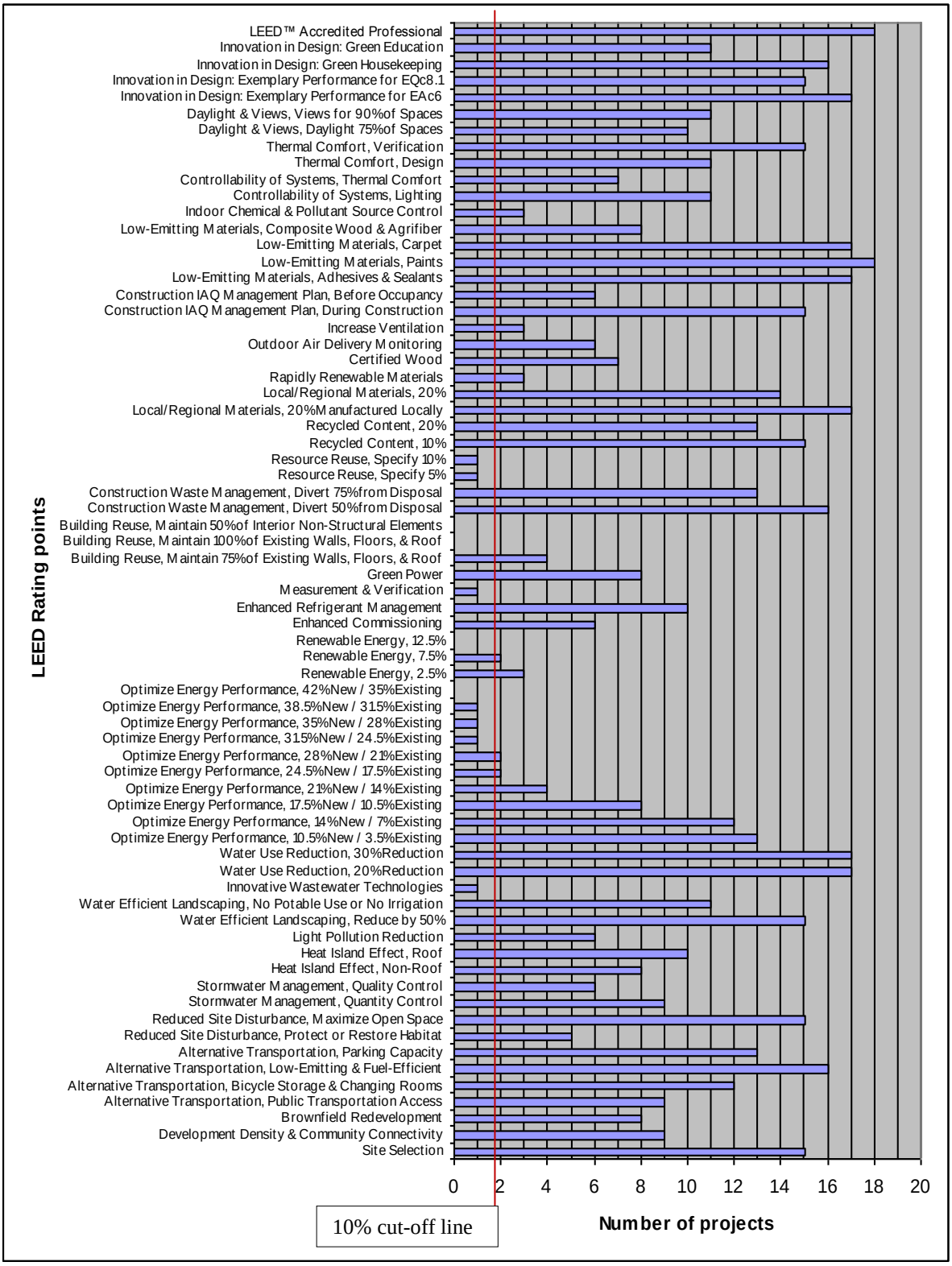


Figure 31: LEED rating points pursued in LEED 2.2 for a Gold rating of projects

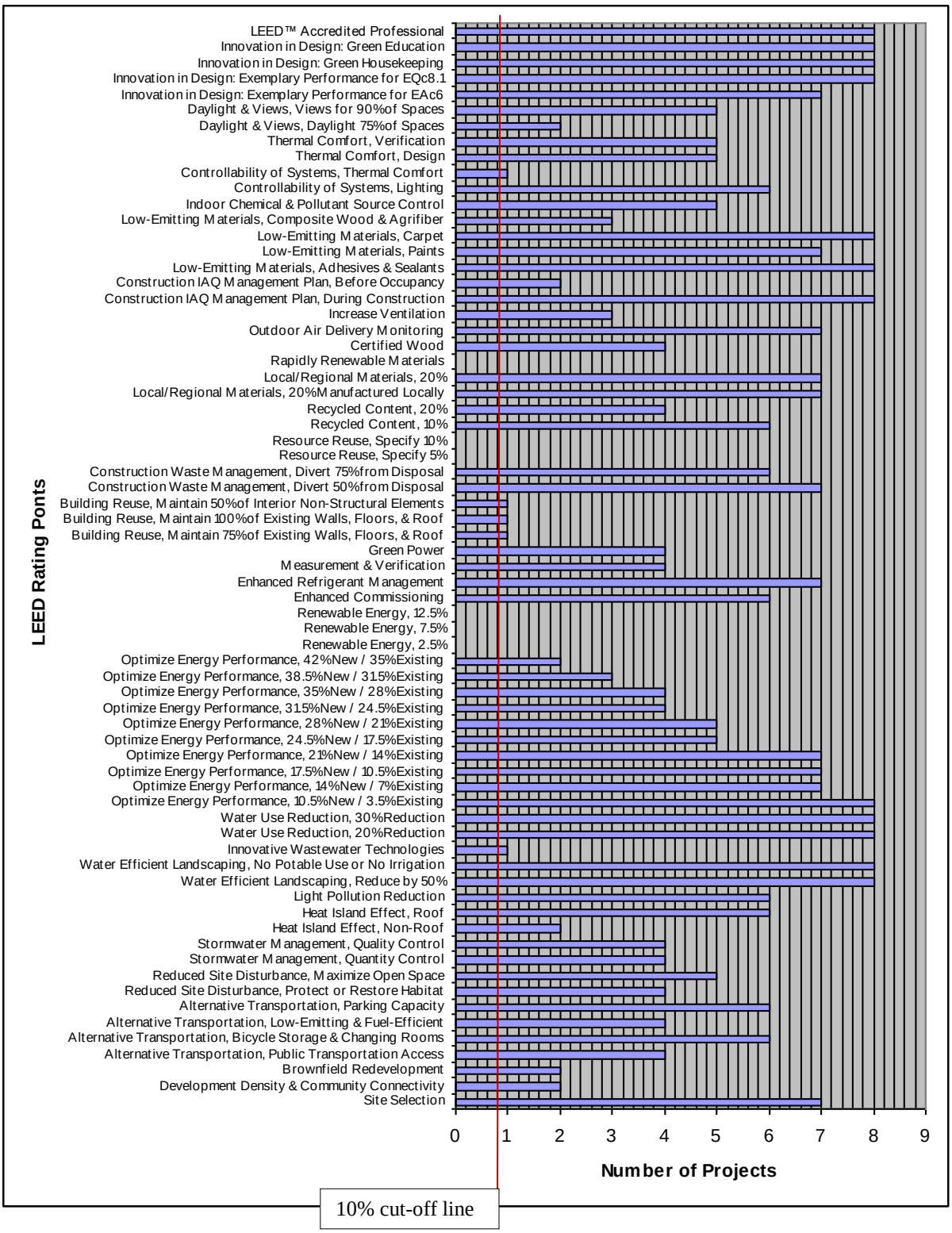


Figure 32: LEED rating points pursued in LEED 2.2 for a Platinum rating of projects

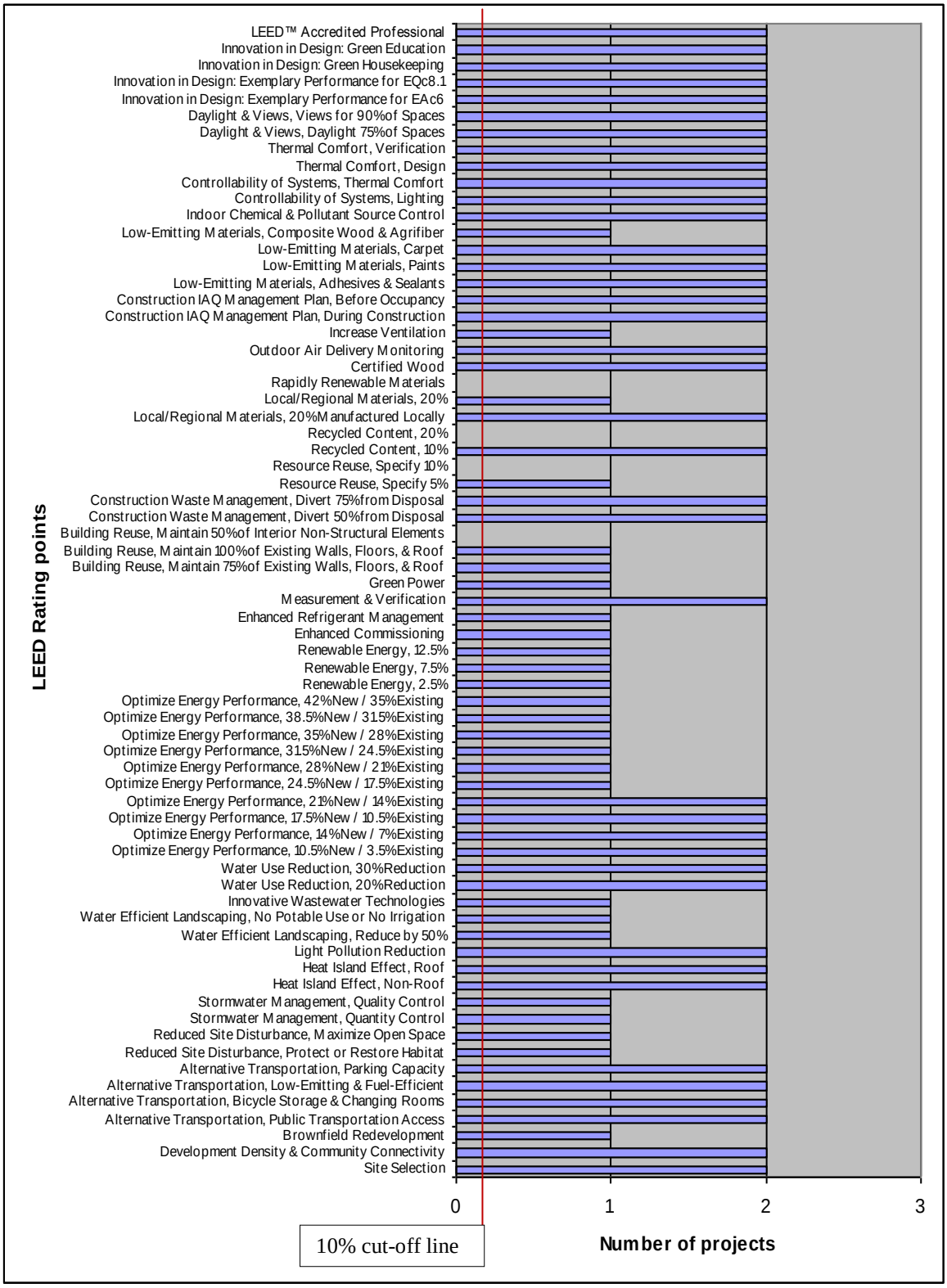
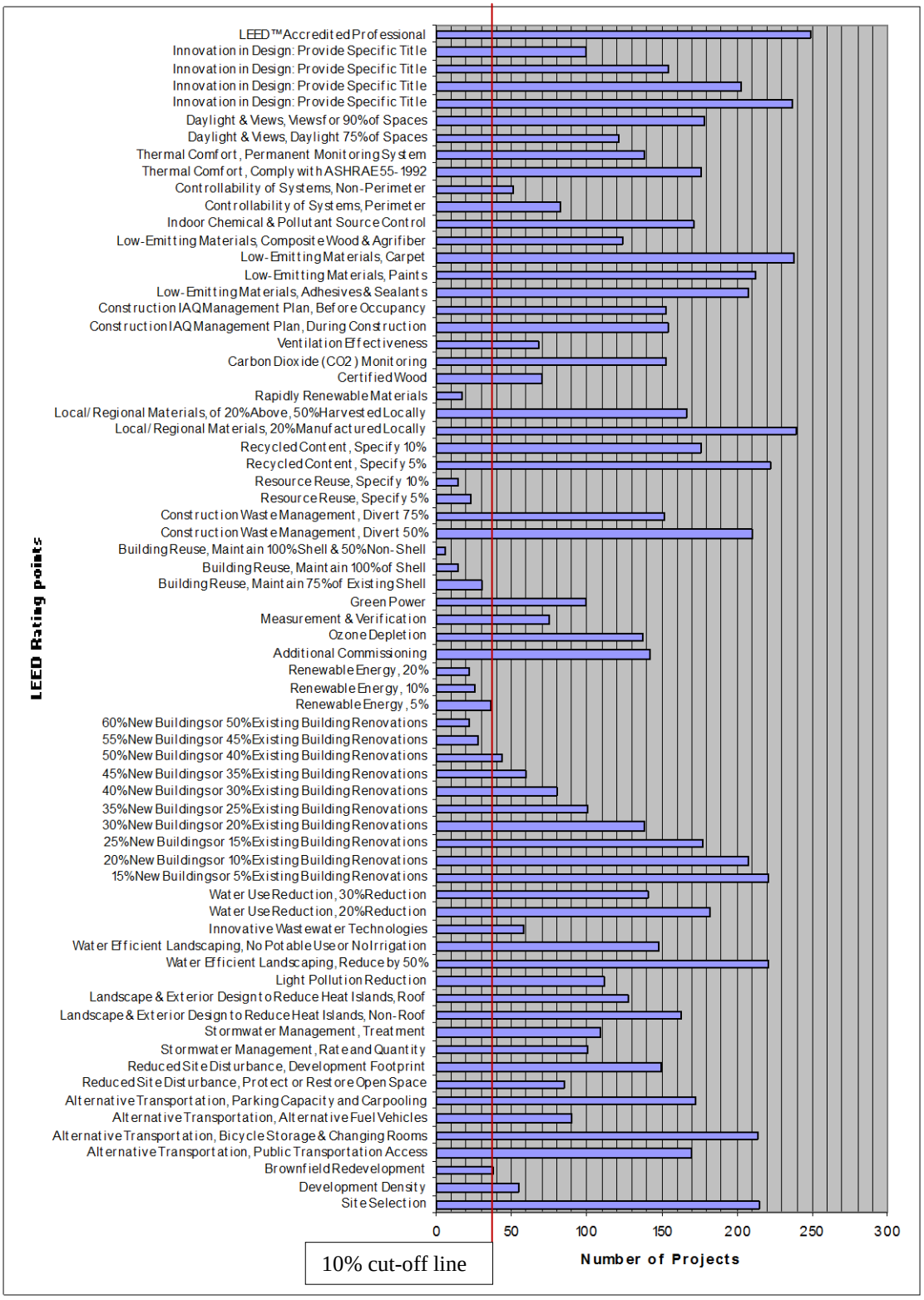


Figure 33: LEED points pursued in LEED 2.2 irrespective of the level of rating



APPENDIX-B

The points that have been change in LEED NC 2.2 version in comparison to LEED NC 2.1 are (acronyms per LEED standards: SS Sustainable Sites; EA Energy and Atmosphere; MR Materials and Resources; EQ Environmental Quality):

SSPr-1	Construction Activity and Pollution Prevention
SSCr-2	Development Density & Community Connectivity
SSCr-5.1	Site Development, Protect of Restore Habitat
SSCr-5.2	Site Development, Maximize Open Space
SSCr-6.1	Storm water Design, Quantity Control
SSCr-6.2	Storm water Design, Quality Control
SSCr-7.1	Heat Island Effect, Non-Roof
SSCr-7.2	Heat Island Effect, Roof
EACr-2.1	On-Site Renewable Energy (2.5%)
EACr-2.2	On-Site Renewable Energy (7.5%)
EACr-2.3	On-Site Renewable Energy (12.5%)
EACr-3	Enhanced Commissioning
EACr-4	Enhanced Refrigerant Management
MRCr-1.1	Building Reuse, Maintain 75% of Existing Walls, Floors & Roof
MRCr-1.2	Building Reuse, Maintain 100% of Existing Walls, Floors & Roof
MRCr-1.3	Building Reuse, Maintain 50% of Interior Non-Structural Elements
MRCr-2.1	Construction Waste Management, Divert 50% from Disposal
MRCr-2.2	Construction Waste Management, Divert 75% from Disposal
MRCr-3.1	Materials Reuse 5%
MRCr-3.2	Materials Reuse 10%
MRCr-4.1	Recycled Content, 10% (post-consumer + ½ pre-consumer)
MRCr-4.2	Recycled Content, 20% (post-consumer + ½ pre-consumer)
MRCr-5.1	Regional Materials, 10% Extracted, Processed & Manufactured Regionally
MRCr-5.2	Regional Materials, 20% Extracted, Processed & Manufactured Regionally
EQCr-1	Outdoor Air Delivery Monitoring
EQCr-2	Increased Ventilation
EQCr-4.3	Low-Emitting Materials, Carpet Systems
EQCr-4.4	Low-Emitting Materials, Composite Wood & Agrifiber Products
EQCr-6.1	Controllability of Systems, Lighting
EQCr-6.2	Controllability of Systems, Thermal Comfort
EQCr-7.1	Thermal Comfort, Design
EQCr-7.2	Thermal Comfort, Verification

The difference between the LEED NC 2.1 and LEED NC 2.2 requirements to earn the less preferred points are:

1. Energy & Atmosphere: Credit 1.9 – Optimize Energy Performance
    a. LEED NC 2.0/2.1 - 55% New Buildings or 45% Existing Building Renovations
    b. LEED NC 2.2 – 38.5% New Buildings or 31.5% Existing Building Renovations.
2. Energy & Atmosphere: Credit 1.10 – Optimize Energy Performance
    a. LEED NC 2.0/2.1 - 60% New Buildings or 50% Existing Building Renovations
    b. LEED NC 2.2 – 42% New Buildings or 35% Existing Building Renovations
3. Energy & Atmosphere: Credit 2.3 – Renewable Energy
    a. LEED NC 2.0/2.1 – 15%
    b. LEED NC 2.2 – 12.5%
4. Materials & Resources: Credit 1.1 – Building Reuse
    a. LEED NC 2.0/2.1 – Maintain 75% of Existing Shell
    b. LEED NC 2.2 - Maintain 75% of Existing Walls, Floors, & Roof

5. Materials & Resources: Credit 1.2 – Building Reuse
    a. LEED NC 2.0/2.1 – Maintain 100% of Shell
    b. LEED NC 2.2 - Maintain 100% of Existing Walls, Floors, & Roof
6. Materials & Resources: Credit 1.3 – Building Reuse
    a. LEED NC 2.0/2.1 - Maintain 100% Shell & 50% Non-Shell
    b. LEED NC 2.2 - Maintain 50% of Interior Non-Structural Elements
7. Materials & Resources: Credit 3.1 – Resource Reuse
    a. LEED NC 2.0/2.1 – Specify 5%
    b. LEED NC 2.2 – Specify 5%
8. Materials & Resources: Credit 3.2 – Resource Reuse (No difference)
    a. LEED NC 2.0/2.1 – Specify 10%
    b. LEED NC 2.2 – Specify 10%
9. Materials & Resources: Credit 6 – Rapidly Renewable Materials (No difference)

APPENDIX – D
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